SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, APRIL 12, 1907

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THE ASTRONOMICAL AND ASTROPHYSICAL SOCIETY OF AMERICA

I

THE eighth annual meeting was held December 27 to 29, 1906, at Columbia University, New York. About sixty-five members attended and thirty-two papers were presented.

President Pickering, on taking the chair, discussed three lines of work which he believed the society should pursue. First, by cooperation to carry out some great routine investigation too extensive to be undertaken by a single observatory. The best example of this was the accurate determination of the positions of the northern stars, by European and American observatories, under the direction of the Astronomische Gesellschaft. Second, to bring together socially astronomers from all parts of the country, especially the older and younger men. The latter may think the work of the older men out of date, but they may find the experience of the older men and their personal acquaintance with the eminent men of still earlier date of great assistance. The older men have much to learn regarding new methods, and the extensive appliances at their command may often be employed to much greater advan-

tage if they keep themselves personally in touch with the most recent developments of astronomical research. Third, the presentation of papers. While hitherto this has been the principal function of this and other societies it is not necessarily the most valuable. General discussions are more interesting and instructive than long technical papers. It may, therefore, be wise to follow the example of some of the engineering societies, and print abstracts of papers for distribution some days before the meeting. A brief statement is made by the author of each paper, and the greater portion of the time is devoted to discussion. The ideal conditions for meetings of the society would seem to be—a large hotel where all would eat and sleep under the same roof, and where the meetings could be held in the same building.

On the afternoon of December 28, a general discussion took place regarding neglected fields of work in astronomy, in which a large number of members took part, and the views expressed were varied and interesting. The president, in opening the discussion, cited a number of examples of fields of work, which seemed to him important but neglected. For example, in the astronomy of position, the formation of a standard catalogue of stars uniformly distributed, having similar spectra, and of nearly the same magnitude. Many troublesome sources of error, like those due to magnitude and color, would thus be eliminated. The variation in latitude should be studied at a series of southern stations like those now in operation in the northern hemisphere. The systematic search for double stars of the ninth magnitude and brighter, undertaken at the Lick Observatory, should be extended to the south pole. Photometric measures of faint stars, of comparison stars for faint variables, of the components of clusters, and of nebulæ are much needed. It is not known whether the spectra of nine tenths of the nebulæ are gaseous or continuous. A wide field is opened in the study of the spectra of bright variables when faint, and of faint variables when bright, of the distribution of faint spectra and of the components of clusters.

The election resulted as follows:

President—Edward C. Pickering.
First Vice-president—George E. Hale.
Second Vice-president—William W. Campbell.
Secretary—George C. Comstock.
Treasurer—C. L. Doolittle.
Councilors for 1907–9—Ormond Stone and W. S. Eichelberger.

The council designated Harold Jacoby to act as editor for 1907–8.

We give below a list of papers presented at the society's sessions, together with brief abstracts furnished by the authors. Some of these have been slightly condensed by the editor.

PAPERS PRESENTED

Distribution of Double Stars in the Zone + 56° to + 90°: R. G. Aitken.

The survey of the sky undertaken at the Lick Observatory to secure data for a statistical study of the number and distribution of double stars is well advanced, but the only large zone completely examined is the one from + 56° declination to the north pole. This region was divided into eight smaller zones, four of which were examined by Professor Hussey and four by the present writer. By counts of the stars on the charts, it appears that 12,299 stars 9.0 or brighter were examined in the region + 60° to + 90°. Of these, 294 were known double stars and 259 more were found to be double, a total of 553 pairs, all under 5″ except seven bright stars, giving a ratio of one double star to every 22¼ stars to 9.0 magnitude.

Tabulated by hours of right ascension and by zones 4° wide, it is found that the

distribution curve of these pairs closely resembles that of the stars to 9.0 magnitude in the same area, but that the double stars are *relatively more numerous in the richer sky areas.*

When only the pairs under 2″, or those under 1″, or the very close pairs, or the brighter pairs, are considered, the same relation is found; as may be seen from the following table which groups the results by quadrants:

TABLE

Zone + 60° to + 90°

Double Stars	0 h. to 6 h. No. Ratio	6 h. to 12 h. No. Ratio	12 h. to 18 h. No. Ratio	18 h. to 24 h. No. Ratio
Under 5″	173 1:19.4	87 1:28.6	86 1:30.2	207 1:18.7
Under 2	113 1:30	56 1:44	66 1:39	132 1:29
Under 1	76 1:44	37 1:67	40 1:65	80 1:48
Under ½	15 1:224	9 1:276	11 1:236	24 1:161
7.5 Mag. or brighter	49 1:68	23 1:108	18 1:144	63 1:61
Zone + 56° to + 60°				
Under 5″	98 1:14.4	35 1:20.4	30 1:22.4	81 1:18.0

The zones north of 60° were examined with the 12-inch telescope, but for fully one half of the zone + 56° to + 60° the 36-inch was used. In this zone 4,257 stars 9.0 magnitude or brighter were examined and 130 new double stars were added to the 114 previously known pairs, giving a ratio of one double star to 17.4 stars to 9.0 magnitude. The table shows that the relations established in the area north of 60° hold true here also, though the ratio in the fourth quadrant is affected by the fact that in this quadrant the work was all done with the 12-inch telescope. It is, therefore, safe to state that in this entire sky area the double stars are relatively as well as absolutely most numerous in the region richest in stars to 9.0 magnitude, that is, in the region of the Milky Way. The study of the local irregularities in the distribution, of which the charts give evidence, is reserved for a later paper.

The Variable RS Persei: IDA WHITESIDE.

Three minima of this star observed this fall indicated a period of a little over thirty-one days, through about two thirds of which the star remained constant or very nearly so. This period also agreed very well with some scattered observations published in the *Astronomische Nachrichten,* and with others made at the Vassar College observatory. At the time predicted for the fourth minimum the star failed to respond, going down very little if at all. It is probably irregular, but more observations are needed to confirm this statement. The range is only about a magnitude, from 8.2 to 9.2.

A Systematic Error in Distance Measures of Close Double Stars: W. H. PICKERING.

In 1900 a series of measures was made of the wide double star μ Draconis. Its components are nearly equal, and their distance is 2″.3. The observations were executed with a 5-inch telescope whose aperture could be reduced by a series of diaphragms to 0.5 inch. A magnification of 300 was usually employed. It was found when the aperture was so small that the disks of the two components were in contact, or nearly so, that the distance between their centers was materially reduced. With an aperture of 0.6-inch the two centers coincided. Had they remained at their true distance apart, their combined image would have been appreciably elongated, instead of which it was perfectly circular.

It occurred to the writer to determine if the same effect was produced in the case of close double stars where large apertures were employed. A selection of suitable cases was made from Lewis's recent publication of measures of the Struve stars. It was found that the apertures employed by the various observers could be divided into three classes, those of about 8 inches, those of 15 inches and those of about 30 inches.

When the separation was so slight that the star disks would have appeared in contact, or nearly so, with the smaller telescopes, it was found that the measures made with them were uniformly about ten per cent. too small. When the images were well separated the large and small telescopes gave identical results.

The early measures made on μ Draconis with the very small apertures indicate that the deviation is a real rather than a subjective one, and that the star images actually approach one another owing to some diffraction phenomenon. It would appear, therefore, that future catalogues of close double stars should always give the reader an opportunity of knowing the aperture employed with every observation. A more detailed account of this investigation will shortly appear in the *Harvard Annals,* Vol. 61.

The Tenth Satellite of Saturn: W. H. Pickering.

The elements of the orbit of the tenth satellite of Saturn, recently published (*Harvard Annals,* Vol. 53), were based on negatives taken at Arequipa in 1904. An examination of another set of negatives taken in 1900 has just been completed. The satellite was found upon them also, but some of the elements of its orbit differ materially from those found in 1904. This is particularly true of the eccentricity and the inclination. The orbit of 1904 was extremely eccentric, and it was noted in the publication above mentioned that in one part the satellite would pass extremely near to Titan. It was further suggested that the peculiarities of the orbit might be due to such a recent encounter.

The orbit of 1900 was found to be nearly circular, at times passing near Hyperion, however. It was not possible to tell from the negatives just when or how the elements had been transformed from those of one orbit to those of the other, if such a transformation had indeed taken place, but it seemed at least as probable as that two satellites should exist with practically the same period. The orbit is still under investigation, and later results will be published in the *Harvard Annals,* Vol. 61.

Photographic Color Photometry of Short Period Variable Stars: J. A. Parkhurst and F. C. Jordan.

The broad problem of astronomical color photometry finds an interesting application in the determination of color changes in short period variables of the δ *Cephei* type. Various observers, by indirect methods, have found that these variables show stronger color at minimum than at maximum. As the spectroscope shows these stars to be binaries, a proof of color change coincident with light-variation would be of the highest importance. A direct determination of such changes is made possible by a suitable combination of color-filter, orthochromatic plate and reflecting telescope. An exposure on an ordinary plate (Seed 27) was followed immediately by one with a filter and Cramer 'Trichromatic' plate, which give visual magnitudes (as described by R. J. Wallace in the *Astrophysical Journal* for November, 1906). The two principal advantages of the method are: (1) the simultaneous determination of visual and photographic magnitudes; (2) elimination of personal equation with its physiological complications, from the visual magnitudes of the colored stars, and the substitution of the peculiarities of the instrumental outfit, which can be definitely stated and exactly reproduced.

Briefly stated, the results confirm the color-changes in the short period variables under observation, the photographic range being greater than the visual; in other words, the color-factor (photographic *minus* visual magnitude) is greater at minimum

than at maximum. Three stars will illustrate the results obtained.

X Cygni

	Visual	Photographic	Color Factor
	M	M	M
Max.	6.28	7.25	0.97
Min.	7.15	8.75	1.60
Range	0.87	1.50	0.63
T Vulpeculæ			
Max.	5.50	6.05	0.55
Min.	6.10	6.90	0.80
Range	0.60	0.85	0.25
S Sagittæ			
Max.	5.33	5.85	0.52
Min.	5.95	6.93	0.98
Range	0.62	1.08	0.46

We have then the following results:

1. Binary systems, showing orbital revolution.

2. Colored stars, pointing to atmospheric absorption.

3. A regular variation in that color (*i. e.*, that absorption).

Standard Photographic Magnitudes: EDWARD C. PICKERING. (By title.)

On the Probable Distance of Orion: HENRY NORRIS RUSSELL.

Almost all the bright stars in Orion are similar in spectrum and proper motion, and are probably at roughly equal distances from us. Their very small proper motions indicate that their parallax is too small to be directly measured, and Gill's observations of β Orionis confirm this view.

But many of these stars are double, and some appear to be physical systems, showing more or less motion—always very slow. It is possible to derive a relation between the parallax and mass of such systems and the observed distance and rate of motion, which, though not exact in any one case, give good mean values when applied to several stars. Tests of this relation on forty well-known binaries show that its probable error for a single case is about 20 per cent. Applying it to nineteen pairs which appear to belong to the Orion group, and to be physical systems, we find for their mean parallax $\pi = 0''.011/\sqrt[3]{m}$, where m is their average mass, and π is subject to considerable uncertainty owing to errors of observation.

There are many spectroscopic binaries in Orion, but orbits have been published for only two. These indicate that the average mass of these stars is about ten times that of the sun (subject to revision when more data are available). This leads to a mean parallax of 0″.005 or a distance of 600 light years.

For reasons already mentioned, this should be regarded only as an indication of the order of magnitude of the true distance. Errors of observation, and also errors of judgment in including as physical systems pairs which may ultimately turn out to be optical, would both tend to make the calculated parallax too great.

The Number and Distribution of Stellar Clusters and Nebulæ: S. I. BAILEY.

The visible universe beyond our solar system is made up of two classes of objects, stars and nebulæ. All star-clusters may be divided into two classes, irregular and globular; the Pleiades serve to represent the former, the cluster in Hercules, the latter. The term nebula may be applied to any nebulous object, whatever its real nature, which can not be resolved into stars. All nebulæ may be divided conveniently into two classes, gaseous and white, the former giving a spectrum of bright lines, the latter an apparently continuous spectrum. The best known example of the former is the great nebula in Orion, of the latter, the great spiral in Andromeda.

Somewhat less than 700 resolvable star

clusters are known in the whole sky. Less than 600 of these are irregular; nearly all are in or near the Milky Way, of which they form an intimate part, as has long been known. More than 100 resolvable globular clusters are known, the distribution of which bears no relation whatever to the Milky Way, although a rich group of such clusters is found in the Milky Way. This appears to be an accident, however, since they do not seek the lines of greatest luminosity. This peculiar distribution of the globular clusters does not seem to have been pointed out before. Discovery of irregular clusters has been practically exhausted by small telescopes, since powerful photographic instruments reveal few new ones. It is probable, however, that the number of known globular clusters will be considerably increased among the so-called nebulous stars.

About 12,000 nebulæ are now known. The whole number in the sky, however, is several times, perhaps many times, greater. The white nebulæ are distributed in cloud-like groups over the sky, avoiding, in general, the Milky Way. The gaseous nebulæ occur probably over the whole sky, perhaps in greater numbers in the Milky Way where the most striking objects of this class are found. The gaseous nebulæ are probably few in number compared with the white nebulæ.

The majority of all nebulæ are spiral, but there are large numbers of nebulous stars, many of which may be faint globular clusters. The relation between spiral nebulæ and globular clusters may prove to be more intimate than is now apparent.

The Nebulous Regions of the Milky Way: E. E. Barnard.

This paper deals with some peculiarities of the nebulosities in the Milky Way. Though in some cases there seems to be every evidence that the stars and nebulosities are freely mixed together, still peculiarities of distribution, etc., show that with few exceptions (such as ρ *Ophiuchi*) the nebulosity does not indicate any tendency to condense about the stars. This is especially striking in the case of the great North America Nebula (so named by Dr. Max Wolf), where to all appearances the stars seem to exist in a vast bed of nebulous matter with no condensation about them individually. In this particular case the identity of the details of the nebula and the groupings of the stars seem to be conclusive proof that the nebula and the stars, apparently in it, really occupy the same part of space. Even in the case of that remarkable combination of nebulosity and stars, *M 8*, the stars seem freely mixed with the nebulosity, but in no case to be centers of condensation. Contrary to this condition, the great nebula of ρ *Ophiuchi* has condensation about the principal stars in that region, including σ *Scorpii*.

A photograph shows the singular nebulosities about γ *Cygni*, where a profusion of curved sheets and wreaths of nebulous matter cover a large part of the sky about the star and extend as far south as χ *Cygni*. A photograph of the nebula about ν *Scorpii* seems to show quite distinctly an obscuration of the light of the stars in that region. Where this remarkable object veils the sky, the stars seem to have decreased in magnitude. It gives the impression that the brighter stars in this region are dimmed and the fainter ones blotted out, as if produced by a thin obscuring veil of nebulosity this side of the small stars. This peculiarity is very strikingly brought out by the photograph.

In *A. N.* No. 3,111, Bd. 130, the writer has given an account, with a sketch, of a group of small nebulous stars

$$(1860\ \alpha = 18^h2^m \pm\ \ \delta = 23°52' \pm),$$

which lies about $1\frac{1}{2}°$ following *M 8*. When

these nebulous stars were examined with the 12-inch of the Lick Observatory in 1892, no connecting nebulosity could be seen. It was noticed, however, in a photograph made with the Willard lens that a nebulous wisp ran toward the group from *M 8*. The photographs made by the writer with the ten-inch Bruce telescope of the Yerkes Observatory at Mt. Wilson in the summer of 1905 show that in this group the nebulous stars are simply condensations in a large irregular mass of nebulosity which extends to and connects with *M 8*.

Apex of the Solar Motion: GEORGE C. COMSTOCK.

It is well known that different astronomers have reached discordant results in seeking to determine the direction of the sun's motion through space. It is the purpose of this paper to present graphically (lantern projection) these several results classified with respect to the average brightness of the stars employed in the determination. When thus classified all determinations indicate a solar motion toward the north edge of the Milky Way, and the discordances in galactic latitude are not great. In galactic longitude, however, there is a well-marked dependence of the position of the apex upon the mean magnitude of the stars with reference to which it is determined. Stars of the tenth magnitude place this apex some 40° farther east than do stars of the third and fourth magnitudes, while intermediate magnitudes furnish intermediate positions. This variation is attributed to a small drift of the nearer stars in the plane of the galaxy and toward the constellation Cassiopeia. This is shared by most of the sun's stellar neighbors and affects the bright stars in larger measure than the faint ones because a larger percentage of the bright stars are included in this drift.

A Comparison Study of Bright Clusters and Nebulæ: S. I. BAILEY.

Field Experience with Transit Micrometers: JOHN F. HAYFORD.

Spectrographic Observations of Stars: EDWIN B. FROST.

Nine spectroscopic binaries were recently discovered with the Bruce spectrograph of the Yerkes Observatory, viz., *RZ Cassiopeiæ, X Cygni,* 13 *Ceti,* ω *Leonis,* 85 *Pegasi,* τ^5 *Eridani,* τ^8 *Eridani,* τ *Orionis,* ξ^1 *Canis Majoris.* (To be published in the *Astrophysical Journal.*)

The Central Eclipse of 1912, April 13: DAVID TODD and R. H. BAKER.

Although the land-totality of this eclipse will be visible for a few seconds only, it is desirable to prepare for observation. The central line extends from Oporto, Portugal, to Oviedo, Spain, the line of subsequent annularity passing close to Paris. These points are given by a definitive calculation of the track, made possible by the courtesy of Professor W. S. Harshman, U. S. Navy, Director of the Nautical Almanac, who forwarded in advance the necessary solar and lunar data which will be embodied in the 'American Ephemeris' of 1912. The change from total phase to annular takes place in the Bay of Biscay, according to the accepted diameters of sun and moon; and it will be well to repeat the computation with slightly varying values. The application of photographic apparatus, operated automatically, may make it possible to obtain a useful and permanent record of this brief totality.

Relation between Stellar Spectral Types and the Intensities of Certain Lines in the Spectra: SEBASTIAN ALBRECHT.

In connection with the measurement of spectrograms obtained at the Mills Observatory in Chili by Professor Wright, an investigation of the individual spectrum

lines was begun, with a view to determining whether there is a shift of any lines which is progressive from spectral type to type. Several lines were found to undergo such a progressive change, as is indicated by the radial velocities obtained from them. An examination of Rowland's tables shows that in most cases, lines apparently single are in reality blends of two or more close components. The nature of the variations is such as to indicate varying intensities of the same components rather than the presence or absence of different components in the different types. The investigation was limited to types *F* to *Mb* inclusive on the Harvard classification. In this classification the sun is of type *G*.

A comparison with Adams's list of sunspot lines gives strong indications that the physical conditions in the stars as we pass from the *F* to the *Mb* type vary in the same direction as from the sun to the sunspots.

It was thought possible that for variable stars of large light changes, traces of velocity variations for some of the lines might be found, corresponding to small changes in spectral type as the stars varied from maxima to minima—and *vice versa*. In the case of *o Ceti* actual changes in the character of the spectrum are well established, though up to the present no appreciable changes in the wave-lengths of any of its spectrum lines have been observed—leaving out of account the large displacements of the bright hydrogen lines. A comparison of the available measures of *η Aquilæ*, a variable star of the fourth class with a range of only 0.8 of a magnitude in light variations, showed evidences of variations in the positions of some lines from light maximum to minimum similar to the variations that were found from type to type. A further study of this variable star is desirable to establish definitely the exact character and amount of these variations.

These variations in the wave-lengths of some of the lines depending on spectral type, will make necessary the exercise of great care in the selection of lines in radial velocity determinations, and a proper allowance for the type.

A Device of eliminating Guiding Error from Photographic Determinations of Stellar Parallax: Frank Schlesinger.

Experience has shown that a fruitful source of error in photographic work is what has been aptly termed the 'guiding error.' This arises from the fact that when the guiding is imperfect, the image of each star wanders from its mean position and these excursions are registered upon the photographic film to a different extent for stars of different brightness. This error is particularly troublesome in parallax work where the star under examination is usually much brighter than the comparison stars. After considerable experimenting the writer adopted the following simple device that seems to overcome the difficulty in a very satisfactory way. A rotating disc was mounted a little below the center of the photographic plate and about ten millimeters in front of it; that is, on the side toward the objective. The disc was made in two halves moving on the same axis, so that the opening left between their edges could be adjusted to any desired angle. The image of the bright star having been brought to the center of the plate and the disc set into motion, a part of the star's light will be occulted in each rotation of the disc. The amount of light that reaches the plate depends only upon the angular opening between the two halves of the slit and neither upon the rate at which they are revolving nor the distance of the image from the center of rotation. The images obtained in this way were free

from any trace of diffraction caused by the edges of the disc-opening and were otherwise indistinguishable from images of fainter stars taken without the occulter. In parallax work the opening of the disc should be so adjusted that the apparent magnitude of the star under examination is about equal to the mean of the magnitudes of the comparison stars. The effect of guiding error will, therefore, almost entirely disappear. Actual measures upon plates taken with this device fully confirm this last statement.

Photographic Observations of Giacobini's Comet: E. E. BARNARD.

These photographs show the almost sudden development of the tail between December 25 and 29, 1905, from a scant trace to a splendidly developed tail. A comparison with a photograph, made by Mr. Duncan at the Lowell Observatory on December 26, limited the time of development to less than three days. The tail underwent remarkable changes from day to day, but through interference from cloudy weather it was not possible with the one set of photographs to distinguish identical features on different dates, even though they existed, to determine the velocity of the tail-producing particles.

On the Distortions of Photographic Films: FRANK SCHLESINGER.

The question as to the amount of distortion that a photographic film suffers during development is not yet settled. The method employed in the present paper is free from some assumptions that have hitherto been made and gives the average amount of the distortions independent of other sources of error. A plate was exposed to the sky and developed and dried in the usual way. It was then measured independently by two observers. Let us call these measurements A' and B'. The plate was soaked in water and then dried. It was now inserted in the measuring engine in, as nearly as possible (within 0.01 mm.), the same position it had occupied and measured a second time by each observer. Instrumental errors were thus eliminated. Call these second measures A'' and B''. Then if e represents the *mean value* of the distortion (in a sense analogous to mean error) and if e_A and e_B are the mean errors of bisection for the two observers, then by appropriate subtractions we obtain

$$[(A'-A'')^2] = [e^2] - 2[e_A^2],$$
$$[(B'-B'')^2] = [e^2] - 2[e_B^2].$$

If we subtract each of the differences $(B'-B'')$ from the corresponding $(A'-A'')$ the result is free from the effect of distortion and we have

$$[\{(A'-A'')-(B'-B'')\}^2] = 2[e_A^2] - 2[e_B].$$

These three equations enable us to evaluate e as well as e_A and e_B. Three plates, each with about 60 star images, were treated in this way and gave $\pm .0008$ mm., $\pm .0006$ mm. and $\pm .0003$ mm., respectively, for the mean value of the distortion of the film. The experiment was varied and improved by spattering an *undeveloped* film with ink and measuring the small and perfectly round dots that were thus obtained, before and after the plate had been cleared in hypo, and thoroughly washed and dried. Five plates treated in this way gave, respectively, $\pm .0006$ mm., $\pm .0006$ mm., $\pm .0014$ mm., $\pm .0015$ mm. and $\pm .0015$ mm. These experiments indicate that the distortions of the film are considerably less than inevitable errors like those of bisection, guiding error, etc. If this conclusion should be confirmed by other observers it must have an important bearing on methods for measuring and reducing plates, since it would follow that elaborate precautions, such as have some-

times been employed for guarding against these distortions, are unnecessary.

Distortions of Photographic Films on Glass: Sebastian Albrecht.

In the winter of 1904 an investigation of the distortions of photographic films on glass plates was undertaken by the writer at the suggestion of Director Campbell and Dr. Perrine. A preliminary investigation showed that if ordinary good care is taken in the treatment of the plate during development, fixing, hardening, washing and drying, there will be no general distortions, *i. e.*, no distortions extending over a large area of the film. Accordingly, the work was continued by a method which would more readily determine the character of local distortions. Photographs of spectra with numerous lines of different widths are very well suited for this purpose. These spectrograms showed that there were local distortions. These distortions were confined in each case to one or a few adjacent spectrum lines, and very rarely covered an area as much as 0.25 mm. square. The displacements of individual points in the distorted area occasionally amounted to 0.02 mm., which on the Crossley star photographs is equivalent to about one second of arc, and on the spectrograms taken with the one-prism spectrograph of the Lick Observatory to a radial velocity of about 80 km. per second (for the H_γ region). Such large displacements as these are, however, extremely rare.

The distortions seemed to be of two different kinds: one caused by an actual movement of portions of the film, and the other by a displacement of the image apparently due to local differences in the sensitiveness of the film. Some of the characteristic shapes of the distorted lines due to the first cause were: a sine-curve, a question mark, an irregular crinkle, an abrupt bend, a gradual bend which was sometimes shared by two and occasionally by three lines, while the lines immediately on either side of the distorted ones were perfectly straight.

The structure and chemical composition of the film are materially altered in the process of development and fixing, so that the strains produced in the subsequent drying need not be exactly the same everywhere in the film as they were before development. In fact, slight local readjustments might be expected, and it is remarkable that the resulting movements in the film should be so few in number, and be confined to such minute areas.

A Riefler Clock and a Self-registering Right Ascension Micrometer: W. S. Eichelberger.

In September, 1903, there was installed at the U. S. Naval Observatory one of Riefler's sidereal clocks, No. 70, with a nickel-steel pendulum and mounted in an air-tight glass case. At the same time the following scheme of observing was undertaken with the 9-inch transit circle; one astronomer would observe fundamental and miscellaneous stars for about two hours before sunrise, would observe the day planets and the sun, and would finish his tour of duty with another two hours' star observing just after sunset; a second observer would then commence and do star work for about six hours; and then a third man would observe a list of stars for about two hours before sunrise. Thus there were frequently three clock corrections determined during the same night by three different observers. Each night from September, 1903, to August, 1904, on which two or three men observed, has been utilized for determining the relative personal equations of the various observers. This interval was divided into five parts and an independent determination of the relative personal equation was obtained for each

of these shorter intervals with the following results:

	E—L	*E—R*	*E—B*	*E—M*
1903	s	s	s	s
Sept. 5 to Oct. 5	+0.210	+0.051		
Oct. 12 to Nov. 13	+0.195	+0.048	+0.188	
1904				
Jan. 30 to Mar. 29		+0.056	+0.139	+0.062
Apr. 3 to May 13		+0.052	+0.119	+0.055
May 24 to Aug. 15			+0.112	+0.019
Weighted Mean	+0.205	+0.052	+0.133	+0.047

The average probable error of one of these individual determinations is $0^s.009$.

All the men except *M* had observed with a transit circle some years before the observations here discussed were begun, yet with one pair of experienced observers there is quite a decided change in the relative personal equation within a few months.

For the same periods and the same pairs of observers the following differences between the largest and smallest value for a single night were obtained.

	E—L	*E—R*	*E—B*	*E—M*
1903	s	s	s	s
Sept. 5 to Oct. 5	0.072	0.053		
Oct. 12 to Nov. 13	0.083	0.050	0.069	
1904				
Jan. 30 to Mar. 29		0.067	0.128	0.137
Apr. 3 to May 13		0.090	0.094	0.040
May 24 to Aug. 15			0.140	0.075

The general mean of all these numbers is $0^s.085$.

In attempting to adopt a mean clock correction for the entire night and to test the irregularity of the running of the clock from day to day, this number is certainly large enough to be annoying. If it is due to irregularities in the running of the clock during the night, a new clock is needed. If it is inherent in the old key method of observing transits, something should be done to improve the method.

To test the clock for periodic daily irregularity another Riefler clock, No. 82, was compared with it every morning and afternoon and frequently twice during the night from January 19 to February 2, 1906, and a second time from February 23 to March 9. Between these two periods Riefler No. 70 was dismounted, cleaned and set up again. The probability that any periodic irregularity that might exist in these two clocks would be in the same phase in both series of comparisons is not very large.

The relative daily rate of the two clocks was in the first period

$$0^s.1426 + 0^s.00052\,t$$

and in the second period

$$0^s.0298 + 0^s.00032\,t.$$

The residuals arising from the comparison of the observed and computed differences between the two clocks were then grouped with respect to the tenth of the day at which the clock comparison was made with the following results:

JANUARY 19 TO FEBRUARY 2, 1906

Decimal of a Day	No. of Comp.	Mean Residual	
		s	s
.0	—	—	
.1	13	+0.004	+0.005
.2	2	+0.008	
.3	1	+0.011	
.4	7	0.000	−0.001
.5	2	−0.014	
.6	5	+0.001	
.7	—	—	
.8	1	+0.008	−0.005
.9	11	−0.006	

FEBRUARY 23 TO MARCH 9

Decimal of a Day	No. of Comp.	Mean Residual	
		s	s
.0	—	—	
.1	15	0.000	0.000
.2	—	—	
.3	6	+0.002	
.4	7	0.000	0.000
.5	—	—	
.6	4	−0.005	
.7	—	—	
.8	—	—	
.9	14	0.000	0.000

Of the 88 separate residuals three quarters are less than 0ˢ.01 each, a quantity that I had supposed less than the uncertainty with which a clock comparison was read from the chronograph sheet.

At the end of October, 1906, the 6-inch transit circle was equipped with a self-registering right ascension micrometer of the Repsold type made by Warner and Swasey.

Previous to beginning the following series of observations, one of the observers had practised with the new micrometer on two nights and the other two on one night each. Two men worked on each of the eight nights, each observing ten time stars. Each man on half of the nights that he worked observed the first list of ten stars, and on the remaining nights the second list. The same twenty stars were used throughout the entire series.

A least-square solution gives for relative personal equation

$$E - F = +0^{s}.001 \pm 0^{s}.012$$

and

$$E - L = -0^{s}.001 \pm 0^{s}.015.$$

The relative personal equation $E - L$ by the key method of observing was $+0^{s}.20$.

The clock rates during these six weeks were also computed by least squares, first giving a weight unity to each rate and, second, a weight equal to the interval between the observations from which it was determined.

The resulting rates are

$$-0^{s}.0436 + 0.000924\,(T - \text{Nov. } 25.0)$$

and

$$-0^{s}.0445 + 0.000997\,(T - \text{Nov. } 25.0),$$

giving as residuals:

$O-C$	Wt.	$O-C$	Wt.
s		s	
−0.011	1	−0.009	8
+0.015	1	+0.017	5
+0.010	1	+0.012	1
−0.023	1	−0.022	2
+0.011	1	+0.012	4
−0.001	1	0.000	13
−0.003	1	−0.003	7
±0.011		±0.007	

A similar discussion of rates obtained by the key method of observing transits gave for thirteen weeks in the spring of 1904 a mean residual of $0^{s}.015$.

We thus see that by the use of the self-registering right ascension micrometer in this series of observations the mean residual of the daily clock corrections is decreased from 25 to 50 per cent. and relative personal equation has disappeared.

Harold Jacoby,
For the Council

(To be concluded)

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION I—SOCIAL AND ECONOMIC SCIENCE

Fifteen different papers and addresses were presented at the New York session. The attendance varied from thirty-five to over a hundred persons. One joint session with Section H was held. In the absence of Professor Irving Fisher, whose address has already appeared in Science, at the opening session, the incoming vice-president for the section, Charles A. Conant, presided, beginning the proceedings with an introductory discussion on banking reform, the substance of which was as follows:

Unless some sound legislation is in due time enacted, our prosperity will be arrested, our rapidly absorbed currency will prove entirely inadequate for business needs, and we must be put at a great disadvantage at home and in our competition with foreign nations in the open markets of the world.

The proposed banknote reform, it should be understood, is not a measure intended

to aid the banks, but to remove restrictions upon the use of credit in this form where it is found to be useful. If the government will remove the outgrown restrictions and require proper security, there can be no danger to any economic interest involved.

Commerce determines the amount of bullion currency, not the government. And this is just what we ask in regard to note issues. The idea that a government can or ought to determine the amount of money in circulation is not held in any civilized country. The government ought only to determine the rules that insure that a currency shall be what it purports to be, and that it shall have stability and flexibility.

The regular papers were presented in the following order:

The Evolution of Property: LOGAN G. MCPHERSON, New York City.

The problems of to-day in the United States are largely problems concerning property. The corporate régime has extended; and attacks upon corporations have extended.

The change from the artisan and the tradesman doing business in a small way to the great organization operating in an extending field, unquestionably marks one of the great transitions in the mechanism whereby property is held and transferred, one of those cataclysms, it being understood that every cataclysm is the slowly accumulated result of forces long at work, one of those cataclysms that has marked the passage from one property régime to another. Three such régimes are clearly discernible in the history of the human race. These are the tribal or gentile régime, the feudal régime and the joint stock or corporate régime of property, representing in a general way the ancient, medieval and modern forms of property evolution.

Under the system of the gens it was every family for itself. Under the system of Cleisthenes it became, subject of course to the modifications of the political government, every man for himself. The régime of the joint stock company has come with that progress of invention through which the efforts of all men are coordinated for the benefit of all men. This régime tends more and more to reach that status whereunder any person who through frugality, thrift, foresight obtains a measure of resource above his living need may participate in the ownership of one or more of the great corporations that produce and distribute the things of material need.

That it is possible for a great organization to produce more cheaply and sell more cheaply, that the ability of administrative officers can be directed into channels for which it is best fitted, that it presents—if properly steered—a formidable resistance to the dangers of both the waves of prosperity and the slough of adversity have time and again been demonstrated in theory.

That in practise all of these advantages have not been attained at all times by all corporations, that in practise all of these advantages may not have been attained at any one time by all corporations, is known to all men. It may even be that there are corporations which have not in practise attained any of these advantages at any time. But it is incontestable that every one of these advantages has been attained at one time or another by one corporation or another; and the ultimate salvation of any corporation lies in its attaining and maintaining in its practise every one of these advantages all the time.

The Concentration of Wealth: HENRY LAURENS CALL, Washington, D. C.

Fifty years ago there were not to exceed fifty millionaires in the whole of the United

States; and their combined fortunes—including the half-millionaires as well—did not exceed a probable $100,000,000, or one per cent. of the then aggregate wealth of the nation. Sixteen years ago the combined fortunes of this class were estimated at $36,500,000,000, or fifty-six per cent. of our national wealth. To-day a bare one per cent. of our population owns practically ninety per cent. of the entire wealth of the nation.

As a result of this wealth concentration, industrial society is practically divided into the two classes, of the enormously rich, and the miserably poor; our 18,000,000 wage earners receive an average of but $400 per year; nine tenths of our business men are, notoriously, failures; our clergy receive an average annual salary of about $500; the average for the educators of the land is even lower; and the income of other professional men in proportion; while of our 6,000,000 farmers, one third are tenants, and the homes of one third of the remaining two thirds are mortgaged, and a debt burden is almost universal.

These conditions are not normal nor the result of national law or causation, but are instead the result of a monopoly of land and mineral resources, of money, of transportation, and other public utilities, as also of industry. This monopoly has, moreover, been brought about by means of the corporation, industrial, financial and public service. It is thus the work of human law alone; the product of vicious institutions. The corporation, as constituted, is in fact a monstrosity in our industrial system.

But if the conditions outlined are the result alone of unjust and vicious institutions, then to law must we look for their correction. The corporation should yet be made cooperative, social, instead of as now the instrument of private greed.

Methods of ascertaining the Cost of Transportation: John B. Daish, Washington, D. C.

From the adjudicated court cases it seems reasonably certain that the method used by the Supreme Court in Smyth *v.* Ames is inaccurate, for the relation which operating expenses bear to gross receipts does not and can never show the cost of transporting the commodities. The method used by the Circuit Court of the United States for the District of South Dakota could not stand the tests applied by the Supreme Court of the United States, which tests, it will be recalled, were different from the method formerly used by that tribunal. The method used by the Kentucky Railroad Commission is clearly more elaborate if not more correct, than the Supreme Court cases.

To determine with mathematical accuracy the cost of traffic, a definite method has not as yet been devised. The difficulty is twofold. First, on the one line of road, with a single equipment, two kinds of traffic are carried. How is the capital to be separated for the purpose of producing revenue upon these two kinds of traffic? Again, the method used by the Kentucky Commission considers the whole schedule of rates, rates in gross, and secures its results in figures per ton per mile. In short, in the same focus it takes a broad survey of all kinds of commodities in the two kinds of traffic and microscopically looks at the smallest possible unit of measurement. The shipment of a box of books is augmented to per ton per mile, a shipment of a car-load or train-load of vegetables is reduced to the same unit. While this unit may be used in mathematics, it can be confidently asserted that it rarely, if ever, enters the head of a traffic manager making rates; ordinarily he does not consider the cost of traffic, for he does not know it.

The difficulties in this matter seem to be the unwarranted assumptions, the legal fictions, as it were, within which there might be such a variation as to cause rates (single or as a schedule) to be unreasonably low on the one hand or extortionate on the other.

The assumptions heretofore made may or may not be true. Until proved correct, we can not hope to ascertain to a mathematical certainty the cost of transportation to the carrier by any of the methods considered or one hereafter to be devised.

Competition versus Combination of Railroads as affecting the Basis of Rate-making: H. G. BROWN, Yale University.

The fact that railroads are operated under the law of increasing returns lies at the basis of the systems of rate making. Increased traffic is carried at proportionately less cost and yields proportionately greater profit. It therefore becomes worth while for a railroad company to get this increased traffic even if somewhat lower rates must be conceded. But lower rates will not be conceded unless there is a compensating increase of business. Reductions will be made where traffic is responsive and only where it is responsive.

Discrimination between different cities is largely due to railroad competition. When two railroads connect a couple of cities by different routes, each has a monopoly of the traffic between intermediate points on its own line. Hence there is discrimination in favor of the through traffic, which is most responsive. The reductions take place on the through traffic not because it is absolutely responsive, not, that is, because by such reductions traffic as a whole can be increased, but only because it is relatively responsive, because traffic is so gained by one road at the expense of another. If in the absence of competition reductions are made in favor of traffic between any two places, it will only be when such traffic is absolutely responsive, when the total traffic of the district served is thus increased.

The discriminations among different shippers, which have been so common with competing railroad companies, are similarly explainable. The concessions to large corporations forced by the threat to transfer patronage to another railroad are concessions made where considerable traffic is in question, where, therefore, traffic is responsive and where it is relatively responsive. It is not so much that these discriminating reductions increase traffic as a whole as that they increase the traffic of one company at the expense of another.

The tendencies of competition and of combination to affect diversely the basis of rate charges, whether among different cities, among different corporations, or among different commodities, have been reduced to the generalization that rate reductions will take place *where* traffic is sufficiently responsive to such reductions and *only* where it is sufficiently responsive. With competing roads it is chiefly relative responsiveness and with non-competing roads it is absolute responsiveness only that determines a lowering of rate.

Psychic Factors in the Fluctuation of Prices: RICHARD T. COLBURN, New York City.

The first decade of the twentieth century has many surprises for America and for Europe, political, social and financial; and in none more remarkable than the expansion of commerce and credits. These are not accurately reflected by the visible balance of trade figures, but by an invisible ledger balance of credit. This is born of confidence—a state of mind—our credit is good, perhaps too good. We are the good customer of tradition, suggestive of the spendthrift.

The 'economic man' of the text-books is unlike the actual man (and woman) of society, because he is often swayed by a group of impulses, emotions and psychic phases which have little reference to his gain or loss and range into the irrational or pathological. Many illustrations might be given from history or from current events. The inflation of stock-exchange dealings, real-estate booms; speculative 'buying for a rise' in commodities, holiday gifts, bargain-counter rushes; wedding, funeral and religious expenditures. The imitation of the crowd seems a large factor, and in spite of the spread of knowledge and useful inventions, the range of rise and fall in prices is more extreme and the psychic factors equally important.

Economic and Social Conditions of Porto Rico: John L. Hogan, New York.

The main need of this people is now initiative and leadership in lines of productive enterprises with which the Porto Ricans are themselves more or less acquainted and which are based on utilizing their natural resources and their climatic advantages, as in the growing of tropical fruits, canning vegetable products, etc. Their talent as lace-makers is a fine art that is being developed by at least one company which is introducing the needlework of Porto Rican women and children to the markets of the United States. The government has succeeded only moderately in promoting prosperity; the main reliance is now and always on far-sighted private enterprise.

The Charter and Work of the Board of Education of St. Louis: Calvin M. Woodward, St. Louis.

The discussion of the subject included details of the charter, the reasons for its adoption, the organization and work of the board, its non-partisan character and how it is maintained. Some obvious fruits of the general policy adopted by the board were described. The reports of the board give much information on these topics.

Ethical Training for Efficient Citizenship: Felix Adler, New York.

An outline of the qualities which have been regarded as essential for good citizenship, from the days of Plato (see his 'Republic') and Aristotle (see his 'Politics') to the present time.

Training for Physical Efficiency as an Aim of Education: G. O. Brewster, New York.

Present methods of physical training aim to improve the body in both normal and abnormal conditions. Exercises known as hygienic and corrective are employed to this end. The highest aim of education is the development of reason, and reason must have facts as a basis. In present methods of physical education I have been unable to discover reason, inasmuch as there are no facts or definite knowledge of the chief subject under consideration employed. The chief consideration is the individual, and a definite knowledge of himself is necessary to a reasonable understanding of his work in physical education. The smattering of physiology and hygiene, which the pupil receives during the formative period of life, aims to conceal rather than reveal the facts of life, from fecundation to birth and from birth to death.

Our aim is supposedly to leave better men and women in our places than we are, and to accomplish this result we must give them the benefit of our mistakes through our lack of knowledge or whatever cause regardless of pride and personal feeling.

In my experience in school teaching and the practise of medicine in this city, I came to feel that ignorance of the structure and functions of the body was accountable for the majority of humanity's ills.

Therefore I believe it necessary to the physical training of our youth, *not* that they should receive more exercise or mentally exhaustive and complicated drills for the exercise of muscles and functions of which they know nothing, but that instead they should receive simple, recreative exercises graded according to their physiological knowledge of themselves, and so applied that they can know what occurs in their physiological economy when they exercise either body or mind—to the end that physical efficiency be increased as abuses decrease and the standard of life proportionately raised.

Standards of Social Efficiency in School Policy: JOHN FRANKLIN CROWELL, New York.

There are three requisites by which school work has to be judged to determine its level in the scale of social worth. They are the economic, the political and the spiritual standards.

The economic standard of efficiency requires that the school training shall first of all bend its efforts to guarantee to the individual the capacity to make a decent living and maintain a respectable livelihood for himself and those rightfully dependent upon him.

The political standard requires that the individual have that degree of intelligence and self-expression to participate in constructive discussion on questions involving the common welfare.

The spiritual standard requires that there be developed in each pupil the love of things moral, intellectual and spiritual so that he may appropriate for himself the best that our civilization affords.

Some Results of Research in Child-employing Industries: OWEN R. LOVEJOY, Assistant Secretary National Child Labor Committee.

The census for 1900 shows 1,750,178 children between ten and fifteen years engaged in gainful occupations. The majority are in agricultural labor, but the numbers increase most rapidly in the industrial trades. While the chief evils are in the great industrial centers, we have found poverty, ignorance and neglect of a large number of children in country communities. There is evidence that, in some branches of agriculture the hours of labor and housing conditions are sufficiently alarming to warrant the careful regulation of child labor in agriculture.

Research in manufacturing and mechanical pursuits, mercantile establishments and street trades, indicates that as soon as childhood shows its capacity for any specific form of labor, industry at once seizes it, and posits an economic necessity for so doing; that the physical effects of child labor are a menace to society; that the effect upon family income is detrimental; and that child labor tends to industrial deterioration.

While many phases of our research must be carried on for several years before positive results are announced, we believe we are justified in urging the following demands in opposition to child labor: (1) The regulation of all industries in which children are employed, (2) the entire elimination of the child under fourteen as an industrial factor, (3) the restriction of employment for children between fourteen and sixteen, prohibiting the defective and the illiterate and carefully regulating the hours and employment of others, (4) the agreement of age standards in child labor laws and compulsory education laws and the fitting of our educational curriculum to the needs of our population, by providing such training of the hand as will appeal to the parents as promotive of the future industrial efficiency of their children.

News Service and Political Science: Franklin Ford, General News Office, New York City.

The gathering and sale of news for a profit is a modern development. It was hardly sold at all before the time of Charles II. in England. Of one thing you may rest assured, that when some man in London first conceived the possibility of getting his living by the gathering and sale of news, that day unjust privilege had, clearly and definitely, started on the road to its last ditch. And if you wish to dramatize this assertion you have only to think of a pack of reporters at the heels of derelict life-insurance officials.

The fast press and the talking wire have come in, but the manner of classifying and handling news—the mode of interpretation—has not changed essentially. True organization in the field of news has been waiting on the introduction of a new point of view, of a new way of ideas. Scientific method has entered nearly all the great branches of manufacturing, but a new co-ordination has yet to obtain in news handling.

To organize news we must classify it, which implies a science of news. But, as already indicated, since the news movement relates to all organs or functions in the social body, the desired science must in the nature of things be the science of Politics. Call it sociology, if you will; there is no difference.

The pending advance in news organization to the level of the highest integrity introduces the oncoming new legislature, or the fact-finding and law-declaring organ. News is the universal element of social control.

From the business standpoint, when a new fact is disclosed in the news movement it carries three possible sales or profits: (1) Its general application to be distributed through the daily paper, (2) its class application to be sold through the trade paper, and (3) its special application to individuals which they can buy through the bureau of information.

The Rate of Sickness as determined by the Companies doing Health Insurance in the United States, particularly, the Experience of the Travelers Insurance Company of Hartford: Hiram J. Messenger, Hartford, Conn.

The first attempts to write health insurance in the United States were made about sixty years ago and all efforts following these attempts up to about 1897 were practically failures on account of the lack of knowledge of the business and lack of solid financial backing. About 1897 a stock accident company commenced doing health insurance, first by issuing a special health policy limited to fifteen diseases which was later increased to twenty-one and then to over thirty. The general tendency was towards a more comprehensive contract and after a few years most of the companies were issuing a health policy which covered practically all diseases. The experience of the Travelers Insurance Company on their special health policy shows .29 of a week of sickness for each year of exposure for ages 18–25, and gradually decreases to .18 for ages 40–49, and then increases to .30 for ages 55–60. On the general health policy the number of weeks sickness per year of exposure is about .65 for ages 18–50 and then rapidly increases to .95 for ages 55–60. Several of the accident companies have combined their experience on their health policy, covering practically all diseases, with the result giving a rate of sickness about 60 per cent. of the Travelers' experience.

The Manchester Unity's experience of England shows .81 of a week of sickness for ages 16–19 and from there on gradually increases to 1.44 for ages 40–44 and 3.76

for ages 55–59, representing risks that have been under observation for a longer period.

Special investigations in connection with this experience show in general that there is considerably more sickness among the outdoor industrial classes than among the indoor industrial classes and slightly more sickness among the indoor industrial classes than among the clerical and professional classes. The amount of sickness in the north and west is about the same and in each case is less than in the south—while the amount of sickness in large cities is less than in the small towns.

The following subjects were read by title:

Two Neglected Subjects of Social Economy, including interment and cremation considered from sanitary and sentimental standpoints: by MRS. L. OSBORNE TALBOTT, Washington, D. C.

Relation of Death Rates and Birth Rates, applying well known natural laws to the explanation of sociologic phenomena, and concluding that the far-reaching sociologic effects of the reduction of the birth rate are reduction of death rate, survival of the most intelligent, loss of physical robustness, and growth of higher civilization and democracy: CHARLES E. WOODRUFF, U. S. A., Plattsburg, N. Y.

The Brain and Education: THOMAS M. BALLIET, New York University. The main thesis being that while our knowledge of the brain is too scanty to build a theory of education on it, neurology can throw many side-lights on educational problems.

J. FRANKLIN CROWELL,
Secretary

SCIENTIFIC BOOKS

Chemical Abstracts. Published by the American Chemical Society. Edited by WILLIAM A. NOYES and C. A. WATERS, with the co-operation of a large staff of assistant editors and abstractors. Published semi-monthly. Easton, Pa., Chemical Publishing Co. Vol. I., No. 1, January 1, 1907. Price, $6.00 per annum.

Brief abstracts are given of all chemical investigations of any importance published in any part of the world. These abstracts are classified under the following sectional headings, each section being in charge of an expert in that particular branch of chemistry: Apparatus (Walker); General and Physical Chemistry (Lewis); Radioactivity (McCoy); Electrochemistry (Whitney); Photography (Friedburg); Inorganic Chemistry (Smith); Analytical Chemistry (Dennis); Mineralogical and Geological Chemistry (Hillebrand); Metallurgy (Richards); Organic Chemistry (Bogert); Biological Chemistry (Mendel); Foods (Bigelow); Nutrition (Langworthy); Water, Sewage and Sanitation (Kinnicutt); Soils and Fertilizers (Veitch); Fermented and Distilled Liquors (Wahl); Pharmaceutical Chemistry (Stevens); Acids, Alkalies and Salts (Briggs); Glass and Pottery (Barton and Bleininger); Cements and Mortars (Drew); Fuel, Gas and Coke (Pennock); Petroleum, Asphalt and Wood Products (Sadtler); Cellulose and Paper (Little); Explosives (Munroe); Dyes, Bleaching and Textile Fabrics (Olney); Pigments, Resins, Varnishes and India Rubber (Sabin); Fats, Fatty Oils and Soap (Richardson); Sugar, Starch and Gums (Browne); Leather; Patents (U. S., British, German and French) (Seaman).

The appearance of this journal marks an epoch in the progress of chemistry in America, and is an achievement of which the American Chemical Society may well feel proud. The establishment of such a publication has been made possible by the untiring efforts of the editor, Dr. Noyes, and the loyal support of more than 130 of the leading chemists of the country who are acting as assistant editors and abstractors either gratuitously or at a merely nominal remuneration. The society is to be congratulated also on the fact that it has had the courage to undertake this publication single-handed and without entering into 'entangling alliances' with any other organiza-

tion. This simplifies greatly the business management of the venture, insures more rapid appearance of the abstracts, and should appeal strongly to the patriotism of all American chemists. It was feared at the outset that the project might not be a financial success, and that the necessary increase in the membership dues from five dollars to eight dollars would be followed by many resignations. This fear was apparently groundless. But few resignations have been received as the result of this increase in dues. On the contrary, the membership of the society is now increasing more rapidly than ever before.

The value to the profession of such a journal can scarcely be overestimated. It will not only bring before every American chemist a concise summary, in his own native tongue, of all important chemical investigations, thus enabling him to keep abreast of the progress of the science, stimulating and encouraging research, but, furthermore, as it covers all branches of the subject, it should prove a most potent factor in drawing together in bonds of closer cooperation all chemists in this country.

Its only rival at the present time is the *Chemisches Zentralblatt* of the German Chemical Society, which has had a monopoly of this field for many decades. It is much more expensive than *Chemical Abstracts,* and in some respects (notably on the technical side) is not so complete. On the other hand, the German publication is superior to ours in certain points—it appears weekly, instead of twice a month; diagrams and illustrations are more freely used; and the abstracts do not have to be condensed quite as much, not only because they have more space available, but also because of a much more extensive use of abbreviations.

In *Chemical Abstracts* the American Chemical Society has produced a most excellent journal, and all American chemists should rally to its support, to make it, as it should be, the best of its kind in the world. Those who are not already members can best assist by joining at once and urging others to do likewise.[1] Marston Taylor Bogert

[1] The secretary of the society is Dr. W. A. Noyes, Bureau of Standards, Washington, D. C.

SOCIETIES AND ACADEMIES

THE AMERICAN PHYSICAL SOCIETY

A regular meeting of the Physical Society was held in Fayerweather Hall, Columbia University, on March 2, 1907. In the absence of the president, Professor W. C. Sabine was made temporary chairman.

An address was delivered before the society by Professor O. Lummer, of the University of Breslau, on 'The Temperature of the Sun and Recent Solar Theories.'

The following papers were then presented:

E. F. Northrup: 'On the Forces on the Interior of a Conductor Carrying Current.'

C. W. Waidner and G. K. Burgess: 'The Radiation from, and the Melting Points of, Palladium and Platinum.'

F. M. Pederson: 'The Viscosity of Certain Isomeric Ether Compounds.'

J. G. Coffin: 'The Effect of Frequency upon the Capacity of Absolute Condensers.'

C. C. Trowbridge: 'The Physical Nature of Meteor Trains.'

C. C. Trowbridge: 'On Atmospheric Drifts above Fifty Miles from the Surface of the Earth.'

C. C. Perry: 'On the Current carried by Canal Rays in a Discharge Tube.'

Carl Barus: 'The Equations of the Fog Chamber.

W. G. Cady: 'Note on the Hissing Metallic Arc.'

F. L. Tufts: 'The Relation between Luminosity and Electrical Conductivity of Flames.'

Ernest Merritt,
Secretary

THE BIOLOGICAL SOCIETY OF WASHINGTON

The 425th meeting was held on February 9, 1907, with President Stejneger in the chair.

Dr. A. D. Hopkins read a paper, illustrated with lantern slides, on 'Some Results of Anatomical Investigations of the Thoracic Segment of Insects.' The substance of this paper will appear in a bulletin of the Bureau of Entomology.

Mr. T. H. Kearney spoke on 'The Date Palm in the Northern Sahara,' illustrating his subject with a large number of lantern slides. He described the oases of southern Tunis and especially the group known as the Djerid, where numerous fine varieties are grown. Methods of irrigating, cultivating, pollinating

and harvesting were discussed. Attention was called to the great number of varieties existing in this region and to the characters by which they are distinguished. A description was given of the Oued Souf oases in eastern Algeria and of the peculiar method of growing date palms there in 'sunken gardens' among high sand dunes. The efforts of the Department of Agriculture to establish date culture in the southwestern United States were also discussed.

THE 426th meeting was held on February 23, 1907, with President Stejneger in the chair.

Mr. C. V. Piper presented a paper extensively illustrated by lantern slides, on 'Some Features in the Distribution of Life in the Columbia Basin.' The Columbia Basin comprises practically all of Washington and Oregon east of the Cascade Mountains and the greater part of Idaho. This region is entirely covered with the Columbia lava of an average thickness of about 1,000 meters. The central portion of the basin is the lowest, ranging from 150 to 300 meters altitude, from which it gradually rises in all directions to the surrounding mountains. The Cascade Mountains on the west, the Bitter-Root and Rocky Mountains on the east as well as the Blue Mountains, are inhabited mainly by boreal plants and animals pushed southward during the glacial period. The lowest part of the basin is occupied by the upper Sonoran plants and animals and the intermediate region by arid transition forms.

In studying the inhabitants of this region statistically, it is found that, if plants of continental range be excluded amounting to about 30 per cent. of the whole, that the following proportions appear. Of upper Sonoran plants, 7 per cent. are of California origin, 64 per cent. of Great Basin origin and 29 per cent. are endemic. Of the arid transition plants 33 per cent. are of California origin, 26 per cent. of great basin and 31 per cent. endemic. It will be noticed, on comparing these figures, that Californian arid transition species have much freer access to the region than upper Sonoran species. Indeed, at the present time the arid transition area is still continuous from California into the Columbia Basin. This with the prevailing southwest winds is probably the reason why these plants dominate over those of Great Basin origin in the Columbia Basin, though the latter apparently have much easier access. In the Columbia Basin the upper Sonoran life area is practically coextensive with the area where the rainfall is 12 inches or less and the characteristic plant is the common sage brush.

A second point of interest in the distribution of plants in this region, is the relation which exists between the plants of the Blue Mountains, those of the northernmost part of the Cascade Mountains and those of the Siskiyou Mountains. These regions are composed largely of granitic mountains and in each of them there is a considerable number of peculiar species. It was suggested that the explanation of this was to be found in the fact that the greater portion of the Cascade Mountain region is volcanic in character and comparatively recent in origin. It is possible, therefore, that the plant species peculiar to the granitic regions either prefer granitic soils or else through volcanic conditions have disappeared from the greater portion of the Cascade Mountains. While neither of these explanations is entirely satisfactory the fact of the peculiar relations of their floras is very clear.

Another striking feature mentioned by the speaker was in regard to the islands in the northern part of Puget Sound. These islands, including the southwest extremity of the Vancouver Island, lie in the lee of the Olympic Mountains and have the lowest rainfall of any of the country west of the Cascade Mountains. The rainfall on these islands varies from 19 to 31 inches, practically paralleling the conditions of the arid transition area east of the Cascade Mountains. The Cascade Mountain form at the present time is a perfect barrier for arid transition and upper Sonoran plants. Nevertheless, in some way a considerable number of such species have found their way to this region of low rainfall in the northern part of Puget Sound. Among these are *Opuntia missouriensis, Juniperus scopulorum, Platyspermum scapigerum, Zygadenus paniculatus, Lupinus microcarpus* and

many others. The speaker stated that he was unable to give any satisfactory explanation as to how these arid land plants could have crossed the barrier of the Cascade Mountains.

In discussing this point, Mr. M. B. Waite suggested that seeds of these plants might have been carried by birds or possibly Indians. The speaker admitted that both of these explanations were possible, although he did not regard either of them as likely. Mr. Vernon Bailey called attention to the distribution of many mammals in the Columbia Basin which virtually coincide with that of the plants.

Dr. Leonard Stejneger presented the next paper on 'The Celtic Horse in Norway.' The Celtic horse (*Equus caballus celticus*) was briefly described by Professor Ewart in 1902 as a small pony from the Outer Hebrides, northwestern Ireland, Shetland, Færœs and Iceland, and more fully characterized in 1904 in a paper on the multiple origin of the horses in Scotland, in which he compares it with the 'Norse horse' (*E. caballus typicus*), the essential differences consisting in different proportions of forehead and snout and in the absence of callosities on the hind legs of the Celtic pony. The latter character at one time was supposed to be of generic value since these callosities are absent in the asses and zebras.

The speaker, during 1905, was able to verify his suspicions that the fjord-horse of western Norway is identical with the Celtic pony by examining a number of pure-bred west Norwegian horses which had no hind callosities and which in other respects also agreed with Ewart's description. The apparent discrepancy between the views of the speaker and that of Professor Ewart relative to the identity of the Norse horse was explained by the fact that there are two native races in Norway, the fjord-horse which is identical with the Celtic, and the valley-horse, or eastern Norwegian horse, which is the one to which Ewart has reference.

The important conclusion to be drawn from the identity of the Scotch and the west Norway pony is that it probably came to the latter country from Scotland simultaneously with and possibly domesticated by the West Norwegian brachycephalic population. This invasion may have occurred in late pleistocene or early post-glacial times, at the same period as a complex assemblage of plants and animals, known as the 'Atlantic' biota crossed from Scotland to west Norway over a continuous land bridge, a question more fully discussed in a paper now going through the press.

In the discussion following Dr. Stejneger, replying to a question, stated that no skeleton or part of skeleton of the Celtic horse is in any museum in this country, and that even in European museums, except that of the Landwirthschaftliche Hochschule in Berlin, but little effort has been made to collect series of the domesticated animals.

Dr. Gill suggested that anatomical characters derived from the laryngeal apparatus might furnish better ground for generic distinctions among the Equidæ than the hind callosities.

M. C. Marsh,
Recording Secretary

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

The 630th meeting was held on the evening of March 2, 1907, President Hayford in the chair. Mr. W. P. White read a paper on 'Melting-point Determinations,' stating that melting points are usually determined at higher temperatures by heating the material steadily and noting the stationary temperature which occurs during melting. With perfectly pure substances, this method presents no difficulties or complications. With practically all substances, however, sufficient impurity is present to make the melting extend through a temperature interval. This effect is greater at high temperatures. The proper curve is then distorted from two causes: (1) The supply of heat from the furnace usually varies. This trouble may be corrected by regulating so as to keep the difference of temperature between the furnace and charge constant. The furnace is then held nearly stationary during the melting. (2) The interior of the charge lags behind the outside during melting; this effect becomes negligible if small charges are used. An ordinary platinum thermoelement can be put naked in a charge

of sodium chloride, melted silicate, etc., without perceptible error, and thus excels the electric thermometer for work with small charges, and even with fairly large ones. The best results have been obtained with about 1 c.c. of material. Error from conduction of heat along the thermoelement may exist, but is very small with bare elements directly immersed.

Mr. E. B. Rosa presented a paper on 'Preliminary Studies in a New Determination of the Ohm,' in which it was stated that various methods of measuring resistance in absolute units have been employed, and the results obtained by different investigators expressed in terms of the length of the column of mercury having a resistance of one ohm, range from 106.21 cm. to 106.34 cm., omitting some of the least accurate determinations. The value taken for the international ohm, 106.30 cm., is uncertain by several units in the last decimal place. If one were to attempt to fix the last figure, or in other words get a value that should not be in error by more than 1 part in 10,000, it would be necessary to use only the best methods and to calculate the mutual or self-inductances involved in the determinations at least to one in 25,000.

The best form of self-inductance to be computed from its dimensions is a single layer winding on an accurately ground cylinder. The formulæ heretofore used for this case are correct only for a current sheet, and the speaker has recently derived the formulæ for correcting this expression so as to make it possible to compute accurately the self-inductance of a winding of insulated round wire.

For the method of mutual inductance, the most favorable case is perhaps two equal coils of large radii, and square cross section, placed at a measured distance apart, and the speaker had recently corrected the formulæ of Weinstein and Stefan, so that the value of the mutual inductance can be calculated with high precision, even when the cross section of the winding is relatively large. He had also worked out a new formula for the method of Lorenz and investigated the magnitude of possible errors due to the thickness of the disc, imperfections of centering and errors in the dimensions. The uncertainty arising from variation in the speed of the disc will be very small, using the method of holding the speed steady which has been in use at the U. S. Bureau of Standards for some time.

A brief account was also given of the effect of moisture on the resistance of coils of wire covered with shellac, which causes the resistance to increase with the humidity, and hence to be greater in summer than in winter. This is prevented by sealing the coils air-tight or by covering them with paraffine.

R. L. FARIS,
Secretary

THE TORREY BOTANICAL CLUB

THE club met on March 12, 1907, at the American Museum of Natural History at 8:15 P.M., with President Rusby presiding. Ten persons were present.

The following scientific program was presented:

Remarks on Regeneration: Miss ELSIE M. KUPFER.

The various meanings which have been assigned to the word regeneration were first discussed. It was brought out that, while some writers would limit the term to the restoration of embryonic tissue in root and shoot, others would include within the scope of the process merely the development of buds present before injury. It seemed best to take the middle ground and consider as a regeneration an organ formed anew after injury or loss.

The different plant organs were used as cuttings and their behavior examined when buds were absent. On the roots which formed shoots it was found that these were not confined to the upper (basal) surface, but could appear from the apical as well, or from the middle of the root. The roots of less than half of the species used formed shoots, while all produced roots not always as true regenerations, but as outgrowths from the uninjured *cambium*. Bundleless stems proved able to root with ease, but were unable to replace the buds which had been cut out. Such parts continued growing for fifteen months without undergoing any tissue change, while a part on which a single bud was left established secondary vascular strands between the bud and

the new roots. The pseudobulb of an orchid proved able to regenerate roots and a shoot from the base, and in a conifer the apparent 'restoration' of a single root on the seedling and in an older stem-part was described. Of eighty-two species of leaves used in experimentation only two new ones were found which produced a shoot, though the large majority formed roots. Modified leaves of various types, phyllodes and bulb-scales, were also found to be able to root. Regeneration was likewise reported in the inflorescence of *Dudleya californica* and *Ruellia rosea,* in the fruits of *Phaseolus vulgaris* and *P. lunatus,* and finally in the 'head' of the alga *Penicillus capitatus.*

An extended discussion followed.

Owing to the lateness of the hour, Dr. Rusby did not present his paper on 'Field Observations of the Past Year,' but exhibited a few interesting plants collected at Oscoda, Mich.

Dr. Southwick exhibited several interesting specimens of the seeds of *Ricinus.*

C. Stuart Gager,
Secretary

DISCUSSION AND CORRESPONDENCE

THE ANTHROPOLOGICAL EXHIBITS AT THE AMERICAN MUSEUM OF NATURAL HISTORY

To the Editor of Science: The March number of the *American Museum Journal* contains a brief description of 'A New Eskimo Exhibit.' In the first paragraph of this article is found the following: "the American Museum stands preeminent among all institutions along the lines of ethnological research amid Arctic peoples. The completeness of the material and data thus assembled has enabled the Museum to install a series of groups and cases which illustrate vividly the home and village life of the Central Eskimo, together with their utensils, implements and weapons and the methods of using them." Those who are familiar with the historical development of the department of anthropology of this institution realize the significance of this article. It seems to point to a change in policy which is so far-reaching and of such importance to all American anthropologists as to deserve consideration. I propose to consider, therefore, the question whether the old point of view is so entirely wrong and the new point of view is so entirely right as to warrant this change which blots out of existence the results of many years' work.

The activity of the department of anthropology in the American Museum of Natural History became very great ten or twelve years ago and continued with increasing strength until about two years ago, at which time there seems to have been a change in the administration. During the ten years above referred to, we find a systematic attempt on the part of those in charge to carry on investigations over an ever-increasing large area as fast as means would permit. As a result of this intelligently directed series of field operations there grew up in the American Museum one of the greatest departments of anthropology to be found in any museum in the world. The plan of exhibition was on the broadest and most liberal scale. One could for the first time in an American museum study in detail the essential and salient features of the culture of a very large number of tribes, especially those of North America and northeastern Asia; and it seemed it was only a question of time and the continuance of the same policy when all cultures, exclusive of that of Europe, would be found adequately represented. It seems doubtful if any institution ever acquired in the same period of time collections of such magnitude or ever accumulated material with such intelligence or exhibited it in an equally sound manner. Here one could really study the culture of tribes, one could study conditions as they exist; one felt that one was not looking at the illustrations of some elementary text-book, but that he had in front of him the data from which the history of the material culture of mankind might be written. One felt instantly in the halls of the department the spirit of investigation and it was everywhere apparent that this was prompted by the desire to advance science and not by the desire to find material which would fit into or harmonize with some ideal scheme of exhibition. One instinctively felt in the presence of these exhibits that one was in close contact with actual conditions and that one

was studying people at close hand, for everywhere was present the evidence of intelligent direction. It was evident that the objects on exhibition were neither placed there with the idea of their beauty nor was their arrangement such as to present primarily a beautiful picture, but rather one felt that as one passed from the exhibit of one tribe to that of another that the dominating features of each culture were so presented that they were apparent, and of course this was due to the fact that the work of collecting and exhibiting had been performed in an intelligent manner. The collections revealed so far as possible the influence of environment both geographical and historical as the culture of one tribe upon that of another. This great series of exhibits properly excited the admiration of anthropologists both at home and abroad, and the wonderful growth of the department in such a short time deserved the admiration of all who were engaged in the study of anthropology.

It seems, however, that the point of view in the installation of this great mass of material was wrong, for on visiting the museum to-day one finds the condition so different from that which prevailed two or three years ago that one necessarily infers that the old point of view is no longer held. It seems, furthermore, that the present condition may be regarded as a visible manifestation of this complete change in policy. The first evidence of a change in the point of view became manifest when the great gallery containing the archeological collection from South America was thrown open to the public. The character of the scheme of installation of this collection was so singular that one felt that possibly an experiment was being tried and that the arrangement of the material might be only temporary and consequently a judgment of the merits of the scheme did not at the time seem justifiable. Since this gallery was thrown open to the public, however, the suspicion has become a conviction that the former ideals have been abandoned and new ones substituted. Thus it now appears that a great part of the ethnological collections are to be removed from exhibition and placed in storage, where, it is said, they will be available for students, and that in their stead will be placed on exhibition a series of type or standard or unit exhibits illustrating certain phases and areas of culture. Two such exhibits are fairly complete and are open to public inspection, namely, the Eskimo and the plains. We have then, on the one hand, the fact that the former scheme of installation has been abandoned, that by far the larger part of the material which was formerly exhibited in the halls devoted to ethnology has been or is soon to be removed and placed in storage, and on the other hand, we have in place of the old series of actual exhibits, certain systematic exhibits of which the Peruvian, the Eskimo and the plains, which are at present installed, may be regarded as typical.

First a word concerning the storage of material. Unquestionably in every institution occasions arise when it becomes necessary to withdraw from public exhibition for a longer or shorter period of time large collections. However necessary this may be, I am convinced that collections, especially those of ethnology, which are forced into retirement always suffer. There is not only the inevitable deterioration which always follows when ethnological specimens are packed away and which is always to be considered, but there is especially that loss of personal interest in such collections which can never be completely restored. The argument that such collections are always available for study is on the whole specious. As a matter of fact, at any rate in anthropology, these collections are rarely demanded for study. The reason for this is, of course, that one does not know what exists in the storage rooms; nor can a catalogue of storage material ever be of such a nature as to make such collections of any great value. When one visits a public institution like the American Museum, which from its size, wealth and position may be supposed to occupy a commanding position in American science, it is not for the purpose of finding what they have in storage but to see what they have on exhibition and to take advantage of the information which may be thus obtained. The student who desires to examine this material, having ascertained that it exists in the museum,

might be reconciled to the idea of storage of the bulk of the collections if they were in glass cases, easily accessible, but it is quite impossible to reconcile the idea of study collections with the character of the storage cases which at the present time are to be found in this institution, for these storage cases are of the flimsiest material, from which it would seem impossible to exclude insects and dust and which apparently might be very easily destroyed by fire. The reasons why stored collections in ethnology lose their vital interest and deteriorate from every point of view and especially fail in the purpose for which they were made are so obvious that it does not seem necessary to dwell longer on the subject.

Of the three collections above referred to, which represent the new ideals of installation in this museum, namely, the Peruvian, Eskimo and the plains, it may be noted first that while they all have certain elements in common they are not consistent one with another, for it seems that in the two ethnological exhibits it was the intention that no duplicate specimens should be shown, whereas in the Peruvian exhibit there is endless duplication. If the Peruvian exhibit is to conform to the other two it should be reduced to one tenth its present size. It is possible, however, that this is contemplated. As this exhibit even in other respects differs from the two ethnological exhibits it may be considered independently of them. Its essential defect is the fact that nowhere in the hall is emphasized the salient features of the culture of the Peruvians, namely, that they were a sessile, agricultural people, living in permanent habitations, possessing domestic animals. On the other hand, we are introduced to such categories as 'objects in stone,' 'objects in wood,' 'objects in bone,' etc., and this fortuitous principle of classification, of course, makes it exceedingly difficult for the student to obtain any idea of the true character of Peruvian culture. It would seem that in installing this collection an ideal scheme was held in mind, that the exhibition cases were conceived of as containing compartments, and each compartment received in advance its label, and that then the attempt was made to find specimens to fit the compartments. Where this was not possible the compartment was left vacant. The absurdity of this ideal scheme of installation, if carried to a logical conclusion, can be easily imagined. It only remains to add that the scientific interest of a great and valuable collection has been almost entirely lost.

An equally absurd phase of this kind of installation is seen in the rearrangement of one section of the Chinese hall, where bronzes have been assembled in certain cases and arranged chronologically, centuries and epochs not represented in the collection being indicated by empty shelves. That these handsome dark bronzes have been placed on the darkest side of the hall is, of course, a minor detail.

Upon examining the Eskimo and plains exhibit it seems that a similar ideal scheme was conceived of and that the great collections which existed in the museum from these two regions were searched to find specimens to fill in the pockets of this scheme. The two collections differ in many ways in detail and must be considered separately. The Eskimo exhibit as it stands conceives the Eskimo as a unit and makes such differences in culture as exist, for example, between that of the Greenlander and that of the Alaskan of very secondary importance. The very fact of any difference existing between the Eskimo of the east and of the west is practically lost sight of in the exhibit, and thus also is lost the opportunity to illustrate the influence of the contact of one culture upon another. Of course, if the culture of the Eskimo is a unit, it is quite unessential that one should know what tribe or tribes lie to the south of them or how they have been influenced by these tribes. It may be pointed out next that apart from this defect the collection gives an impression of the Eskimo which is false and misleading. Prominently displayed in the center of the exhibit is an Eskimo woman fishing in the ice. Owing to its position it might be taken as representing a typical phase of Eskimo culture. Thus a false impression is conveyed, as the Eskimo are not essentially fishers but hunters of sea mammals. Taking the fisherwoman on her own merits, however, the details of the group are misleading, to say

nothing of the fact that men rather than women engage in such pursuits. Of nearly equal importance, owing to its position, is a house scene, bad in detail and misleading. The scene represents a woman by a lamp, the source of light and heat in an Eskimo house, completely clad in winter furs. Near her is a baby sprawling on the floor, also clad in furs. Both figures, of course, should be practically nude. The house is constructed after the manner of a temporary habitation, which is never lined. This house is lined. If the woman and child are properly costumed then the house must be regarded as a temporary structure, in which case its lining is entirely inappropriate. The assemblage of objects about the woman is also misleading and has been made without regard for actual conditions. Thus lying on the floor near the woman, who is cooking, is a man's knife, which is entirely inappropriate, and near by is a little toy kettle, which is, of course, entirely out of place.

And so it would be possible to continue in detail an examination of this entire exhibit. Two or three other points, however, seem worthy of notice. In another case are two figures, one of a woman sewing, the other a man cutting a skin. According to the label the woman is dressed in clothing from Cumberland Sound, while her hair is dressed after the Labrador fashion. She is supposed to be talking to the man who is dressed in a costume from the west coast of Hudson Bay—a truly intertribal gathering. According to the label, the man is cutting a thong from seal skin, the label stating that it is taken from fresh seal skin. In the group, however, the man has a nicely tanned piece of common skin, which is never used for lines. The posture of the man is not only wrong, but absolutely impossible.

The case devoted to the decorative art of the Eskimo is perhaps the weakest and most trivial of the whole exhibit. The motive which determined the selection of the objects is not at all clear. Many of the specimens are such as are made for trade and possess little or no ethnological interest. Among the highly decorated objects of the Eskimo are the bone and ivory pipes of the Alaskan Eskimo. None of these are to be found in the case. There are, to be sure, several pipes in the case, but none are typical of the Eskimo, but rather of the Algonkin tribes of the south. To introduce Peary's pack sledges in an exhibition of this sort does not add to its ethnological value. To characterize this exhibit as a whole, I think the word trivial does it justice. If instead of the great collection formerly on exhibit in which one could study in detail the Eskimo from the eastern to the westernmost division we are to have a single exhibit of this nature it should be accurate at least, so far as the character of such an exhibit will allow.

The plains exhibit is perhaps on the whole less fortunate than that of the Eskimo. While the defects here are equally grave they are not so apparent. The most serious objection to this exhibit is probably the fact that the objects used in making the exhibit have been drawn from two or three tribes, especially the Blackfoot, Sioux and Arapaho, which, while they may be regarded as typical of a certain region of the plains, represent only one phase of the culture which actually exists upon the plains. These tribes as they existed in recent times are non-agricultural, buffalo-hunting, tipi-dwellers. No objection could have been made to an exhibit representing this phase of the life of the plains, but to single out the predominating features of such tribes as these is entirely to misrepresent the plains conditions. To consider a single fact, the habitations of the plains are shown by a full-sized tipi and several tiny models. Thus the inference may be drawn that no other kind of habitation prevailed in this region, whereas many other kinds of habitations were found, such, for example, as the earth lodges of the Mandan, Arikara, Omaha, Pawnee and Tonkawa, the grass lodges of the Wichita and Caddo, not to mention other types of dwellings of other tribes. Of the existence of many kinds of wind breaks, shelters, arbors, etc., no one would suspect. The life of the plains is represented as that of hunters, especially of the buffalo. One looks in vain for facts representing the sessile agricultural populations on the plains. This was once the occupation of all the tribes

just enumerated and it was undoubtedly that of the other tribes until within a comparatively recent period. Turning to the exhibit itself, it seriously fails as a whole to represent adequately the wealth of the house life on the plains. To judge of this failure by a single example, the miniature tipi, thrown open so as to permit a view of its interior, may be taken. The model seems entirely inadequate and appears rather as an interesting toy. Its interior arrangement does not conform to that of the Indian tipi; the beds are represented as on the ground; the leanbacks are not in pairs, and it is equally at fault in other details. The little model consisting of two men, presumably hunters or warriors, for their bows, arrows and shields are near-by, is even more misleading. The group is either intended to represent men preparing a hasty meal while on the hunt, in which case they would not, ordinarily, boil their meat by hot stones in skin vessels, or it represents a process of cooking, in which case it would not be done by men, but by women. The section devoted to the subject of transportation presents some curious features. In the section of the human burden-bearer there is exhibited a pair of moccasins, which, by the way, are a specialized type worn only in winter by certain tribes, several cradleboards typical of no one tribe or group of tribes, while at the top of the section is a poor specimen of a packing strap badly shown.

This plains exhibit, even more than that of the Eskimo, is inconsistent. Whereas the first section of this idealized exhibit treats the plains as a unit, in the latter sections tribal elements appear, thus introducing an amount of detail which, however valuable it may be for scientific purposes, seems out of keeping with the idea of the exhibit. I refer especially to the exhibit illustrating the warrior orders of the Arapaho and Blackfeet. Of course, it would have been possible to have maintained a logical and consistent point of view throughout this exhibit, in which case these specialized exhibits would not appear, but in their stead would be found a general treatment of the religious and social life. No such attempt, however, has been made.

Throughout this exhibit, as in the Eskimo exhibit, is everywhere manifest the result of the conscious effort to make the cases look pretty, to have the object on one's right balance in size with that on one's left, quite regardless of whether it illustrates anything or not. After all, the chief defect of this exhibit of the plains is that, in attempting to illustrate an idealized culture, it not only fails to recognize the actual conditions which exist in that culture, it not only makes it impossible to study these conditions and the reasons therefor, but it assumes that all peoples within this area had a common culture. To illustrate this by a single observation—when a buckskin shirt is shown as the costume of a man the casual visitor would assume that all the men wore buckskin shirts, presumably of this pattern, whereas many Indians on the plains wore no shirts at all. The labels here, as in the Eskimo exhibit, are prolific in number, but generally of a trivial kind, conveying information of a kindergarten nature.

Such exhibits as those above characterized might with some degree of propriety be found in the lower grades of the public school, but they certainly do not seem worthy of an institution which claims to be foremost among American museums. If exhibits of this nature are advisable, it would seem that there is no reason for the concentration under one roof of large collections. If the purpose of the general public is to be served by such exhibits it would seem desirable that the great bulk of the collections which are now being stored should be distributed among some ten or twenty of the high schools of the city, for thus the ideal of this scheme might the more easily and cheaply be realized. Or, again, this type of installation might very well be adopted in a small institution with extremely limited resources, or it might even be adopted for a single one of the great halls of the American Museum; indeed, it is conceivable that one of the halls, such as the north hall of the main floor, might very appropriately, in this institution, be given up to an exhibit, in the briefest and most concise manner possible, which would attempt to represent the great general areas of culture which exist among the different peoples of the earth. Such a hall

would indeed be of great value in a great institution like the American Museum and would amply repay the labor of preparing such an exhibit, for the material for such a hall could easily be selected from the duplicate specimens without making any considerable drain on the exhibit halls proper, which should be devoted to the ethnographic exhibit. But to adopt this as the type and standard of installation for the entire department seems, when one considers the greatness of the collections and the size of the building of this institution, utterly incongruous. In view of the commanding position which this institution holds in America, its example is bound to have a very great influence on all of our public institutions, and one has the right to expect from it work of the highest scientific value, and to expect that through its exhibition halls it shall appeal primarily to the intelligent scientific world.

GEORGE A. DORSEY

THE FORMATION OF LAKE SUPERIOR COPPER

TO THE EDITOR OF SCIENCE: The report of the meeting of the Geological Society of Washington and of the paper from the Geophysical Laboratory of the Carnegie Institution on the artificial production of silver and copper in your number of March 8, 1907, leads me to think I should, in justice, publish extracts from a letter received by me from Dr. G. Fernekes, of the Houghton College of Mines, left undated, but received some weeks ago. In a paper on the theory of copper deposition (annual for 1903, p. 249, etc.) emphasis was laid on the probable importance of chloride solutions in copper formations. Then when I read of Stokes's work in *Economic Geology* (Vol. I., p. 644) I suggested to Dr. Fernekes that he extend it to what seemed to me probable conditions of copper formation. He has been engaged in experiments, including an extensive series of tests of mine waters and minerals, along this line, not yet finished, concerning which I will not pretend to report in full, but just quote one extract to show the kind of results he is getting. An apparatus like that of Stokes's was used. Of course the experiment is not precisely the same as the experiment made in the Geophysical Laboratory, and there is no direct question of priority involved, but they are closely parallel and entirely independent. It is up to me to say this as a 'mutual friend.'

ALFRED C. LANE

I have therefore again tried the action of $FeCl_3$ on $CuCl_2$. When these two salts react on each other in an almost neutral solution, free acid is given off according to the following reaction:

$$2FeCl_2 + CuCl_2 \rightleftarrows Cu + 2FeCl_3$$

$$FeCl_3 + 2H_2O \rightleftarrows Fe(OH)Cl + 2HCl$$

If we constantly neutralize this acid by some alkali such as $Ca(OH)_2$ we can change the above reversible reaction into one which will proceed but in one direction, namely, from left to right as above. On trying this I was pleased to see that every trace of copper was precipitated from the solution and of course calcium chloride was formed as a by-product. I immediately upon this tried calcium silicate as a neutralizing agent, and was delighted in seeing all the copper precipitated. Natural wollastonite was the calcium silicate employed. The by-product in this case was, of course, besides calcium chloride, silica (quartz). The whole thing is now cleared up. That is, three factors were active in bringing about the deposition: copper chloride (or copper silicate and HCl); calcium and sodium silicates, as neutralizing agents; and then minerals with ferrous iron in them.

* * * As to the aluminum: the same happened to it as to the iron. After all the copper was precipitated and the solution was neutral it was thrown out as an extremely basic salt. A trace of chlorine is detectable in most of the minerals around here. How beautifully we will check up with Pumpelly's observations.—The mineral now gone; and the greenstone, etc. * * *

* * * Will send you once more corrected sheet of analyses and further notes as to tests of Cu and Ni thereon.

Yours,

(Signed) G. FERNEKES

RADIUM IN BIOLOGICAL RESEARCH

A Radioactive Microscopic Slide.—In the course of experiments on the effects of the rays of radium on plants it became desirable to observe directly the reaction of the living protoplast to these rays. For this purpose the principle of Lieber's radium-coating was applied in the preparation of a radioactive

microscopic slide. A solution of any desired concentration of radium bromide of known activity is made in a suitable solvent, and applied to the surface of the slide near the center. When the solvent evaporates a film of the salt is left on the slide. The film is protected by a coating of a specially prepared substance. Living cells may now be mounted as on an ordinary slide, and their response, if any, to the stimulus of the rays observed. The coating has the advantage, not only of being sufficiently transparent to light, but easily transparent to the β and γ rays, and in less degree to the α rays also.

Slides of various styles and modifications have been prepared on the above principle by Mr. Hugo Lieber, of H. Lieber & Co., New York City, and their efficacy is now being tested in the laboratories of the New York Botanical Garden. Thus far only plant cells have been studied in this way, but the device could doubtless be used in studying the cleavage of eggs, and other activities of animal cells.

To Discharge Electrified Paraffin Ribbons.—Every user of the microtome has experienced the annoyance arising from the electrification of the paraffin ribbons. The trouble may be easily avoided by any device that will conduct away the charge of electricity as rapidly as it accumulates. If the air were a perfect conductor, the trouble would not arise, but its conductivity is greatly increased through ionization. This ionization may be conveniently accomplished by supporting, near the place where the microtome-knife cuts the sections, a celluloid rod, covered on one end with Lieber's radium-coating. These rods have been used with great satisfaction by the writer to avoid the difficulty mentioned.

C. Stuart Gager
New York Botanical Garden,
New York City

SPECIAL ARTICLES

ELEMENTARY SPECIES AND HYBRIDS OF BURSA[1]

The rearing of over 20,000 pedigreed specimens of *Bursa Bursa-pastoris* (L.) Britton, has demonstrated the presence of at least four elementary species, all of which breed true when self-fertilized or crossed within the limits of the same elementary form. From over thirty hybrid families the fact is derived that these several elementary forms hybridize in strictly Mendelian fashion, each form which went into the cross coming out again in the perfectly pure extracted dominant or recessive form of the parents.

The existence of elementary forms in nature within the recognized limits of the species, differing from one another as do the elementary species of *Bursa,* in the possession of definite characters that behave as hereditary units, presents a condition that is not unique, but one which has an important bearing upon some of the questions that have been recently discussed. Several atypic plants have appeared in the cultures, which have bred true to their atypic characters, when the assumption that they were due to chance crosses would have required that they split into the atypic and typic forms in the ratio 3:1. These occurred in families of which the pollination was not guarded and their status as mutants is in consequence not considered sufficiently secure to be presented in detail at present as proofs of mutation. The fact that throughout these cultures the differentiating characters behaved as units in the Mendelian sense appears to me indubitable evidence that the several elementary species have arisen through mutation and hybridization.

On the basis of allelomorphic differences between different species these elementary species of *Bursa* represent the closest possible relationship between forms belonging to distinct types, since they are seen in most cases to differ from each other by a single distinguishing unit or by two units at most. The fact that *Bursa Bursa-pastoris* is everywhere recognized as a variable species, and the presence of several distinct forms in each of the localities from which material was derived for these studies, show that these elementary species generally grow in actual contact with each other. There is neither geographical isolation nor complete physiological isolation, yet these nearly related elementary forms

[1] Extract from paper read before the joint meeting of Section F and Section G, A. A. A. S., New York City, December —, 1906.

maintain themselves absolutely distinct. This should convince any one who may still entertain any doubt regarding it that in the presence of Mendelian hybridization, no form of physical isolation is necessary for the maintenance of closely related forms. Moreover, these observations on *Bursa* show that Mendelian behavior is a strictly normal natural process and in no manner dependent upon the artificial conditions supplied by garden practise.

When a new form arises, differing from the parent in one or several unit characters, these new characters may be either dominant or recessive to the corresponding character of the parent. Less rarely they are neither dominant nor recessive. The chances of survival under these several possible conditions seem to need discussion, since, in several recent conversations, I have found the notion to prevail that recessiveness is a handicap, and allusions based upon the same idea have found their way into print. This view is quite erroneous; not only has the dominant form no advantage in the competition which the newly arisen elementary species must encounter, but it can be shown that under certain conditions the reverse is true.

If the dominant and recessive forms are equally adapted to the particular environment in which they live, there is absolutely no advantage in favor of either. The second generation of a Mendelian monohybrid contains the same number of pure recessives as of pure dominants, and the heterozygotes continue to produce in each succeeding generation just as many recessives as extracted dominants. The chances that extracted dominants will self-fertilize or that they will cross with other extracted dominants are exactly the same as the chances that recessives will self-fertilize or cross with other recessives. In like manner extracted dominants and recessives will cross with heterozygotes with equal frequency, and the quantitative results in these two cases will be exactly parallel, in one instance giving fifty per cent. of pure dominants, in the other case fifty per cent. of pure recessives. In this equal fashion the struggle will continue indefinitely so long as the premise holds, that the two forms are equally well suited to the conditions under which they must grow.

The situation is different when natural selection favors one or the other of the competing forms. A single extreme case will suffice to demonstrate: Let us suppose that the new form is dominant over its parent, but so poorly adapted to the particular habitat in which it originated that it can not successfully compete with the parent form. All the hybrid offspring resulting from crosses between the mutant and its parent will have the unadapted new form, and when the selection becomes extreme, not only will all the pure-bred specimens of the new form be destroyed, but all the hybrids as well, and in this way every vestige of the new form will be entirely lost. Assuming, on the other hand, that the mutant is recessive to its parent but that in other respects the conditions are the same as before, the extreme selection that is assumed to destroy all the recessive individuals, leaves the heterozygotes living because they have the successful form possessed by the parent species. These successful heterozygotes give rise to a progeny in the next generation including the recessive form, and also a considerable percentage of heterozygotes that may carry the form on to still another generation, and in this way the recessive mutant may be preserved indefinitely under the protection of the dominant characteristics of its more successful parent. Such prolongation of the life of a recessive may serve to tide it over times of special stress, or may continue its existence until the various distributing agents have carried it beyond the limits of the habitat in which it is a failure into others in which it may become a success.

GEORGE H. SHULL
STATION FOR EXPERIMENTAL EVOLUTION,
COLD SPRING HARBOR, L. I.

NEW PROCESSES OF TAKING IMPRESSIONS OF NATURAL MOLDS OF FOSSILS

ONE of the perplexing problems which confront the invertebrate paleontologist is that of finding some substance with which an accurate and permanent cast or impression of natural molds of fossils can be made. In

attempting to solve this problem quite a number of substances have been tried by the writer, such as plaster, gutta percha, wax, modeling clay, etc., and when the relief is not great and other conditions are favorable, some acceptable impressions have been made. In many cases, however, the shape of the mold is such that the opening, through which the cast must be drawn, is too small to allow it to pass, if the above substances are used, or the sculpturing, on the plates of a crinoid, for instance, is so delicate that in drawing a rigid cast out of a rigid mold, the finer markings are destroyed.

The properties which a substance must possess to give a reproduction of the form of a shell over which a natural mold was formed are: (*a*) ability to become liquid or plastic to such a degree that it can be forced into every crevice of the mold; (*b*) little or no shrinkage in cooling or drying; (*c*) elasticity, to insure its resuming its original form after the distortion necessary in drawing the cast out of the mold and (*d*) durability. Glue possesses most of these properties and gives satisfactory casts for some purposes, but they shrink after a day or two. A substance found very satisfactory when the molds are large and the ornamentation not too delicate is the so-called 'roller composition,' such as is used in making the ink rollers on printing presses. This composition, which can be purchased at any printers' supply house, is used as follows: Melt the composition in a double glue pot, to avoid burning, as a comparatively high temperature is needed. Heat the natural molds as hot as they can be handled and thoroughly oil with lard oil just before the composition is put in. Keep the mold hot for five or ten minutes after the composition is put in and stir the composition to allow any air bubbles to rise to the top, otherwise the mold may not entirely fill. After the composition is quite cold it can be removed from the mold and will last for a long time without shrinking. The writer has some casts that were made in 1901 from this substance and they are still in good condition.

When the molds are small and irregular with delicate sculpturing, the writer was unable to get rid of the bubbles or to obtain sharp impressions with the composition. Unvulcanized rubber, such as is used for making rubber stamps, was tried and by vulcanizing it in the molds, under pressure, very satisfactory casts have been made on which the surface markings are perfectly preserved. The process is as follows: Dust the inside of the mold and anything that is to come in contact with the rubber with talcum powder to prevent sticking. Cut the rubber in small pieces and, after cleaning in benzine, pack it tightly into the mold, until the mold is a little more than full; then put the mold in a screw clamp to press the rubber while it is vulcanizing and insure complete contact throughout the mold. The vulcanizing is accomplished by placing the mold in a drying oven heated to 135° or 140° Centigrade. The time required varies from half an hour to an hour or more according to the size of the mold.

Arthur W. Slocom
Field Museum of Natural History

PIERRE EUGÈNE MARCELLIN BERTHELOT[1]

France, for the third time in the space of a few months, mourns the loss of an illustrious savant. Again the nations of the world extend their sympathy. The heroes acclaimed were not martial victors over mankind, whose honors were bought in the price of blood, but men of lofty ideals who conquered nature, brought truth to light, instituted new industries and improved old ones, thus bettering man's physical, and through enlightened thought elevating his moral condition. Truly 'science guides humanity.'

Curie, Moissan, Berthelot! How varied the achievements of each, though each chose chemistry as a field of labor. How differently each worked out his task and how successfully.

Berthelot was born in Paris, October 25, 1827. His father was a physician, and the young man inherited not only a taste for a scientific career, but was schooled most effectually for it. His education at the Lycée Henri IV. developed the taste for historical research

[1] Read at the meeting of the New York Section of the American Chemical Society, April 5, 1907.

which won him his first prize and which later directed his attention to the early history of alchemy, the foundations of our science. His great erudition, his mastery of the Greek language and his love of exactitude in securing fundamental facts have given us nine volumes covering the several topics of these researches. They appeared from 1885–1893 and represent his maturer years when the activities and acquisitions of middle life were subjected to the criticism of a calm judgment. This phase of Berthelot's character is also seen in his frequent minor articles dealing with questions of education, morals and philosophy. He possessed a marvelous memory. He lived in a period when the sciences were rapidly developed. He obtained an extraordinary grasp of their relationship. He lived in an environment which was stimulating. He quickly understood what was fundamental in each, and so at eighty he was one of that type of men, now growing rare because of the intense specialization of our day, known as 'the encyclopedists.'

His first scientific memoir was presented to the Académie des Sciences the twenty-seventh of May, 1850. It described the liquefaction of gases by the pressure secured by the dilatation of mercury. He found that pressure alone would not reduce gases to the liquid state. From that date there was no cessation in his labors; he attended, as its perpetual secretary, a meeting of the Académie within an hour of his death, March 18, 1907.

He became assistant to Balard at the Collége de France and obtained his doctorate in 1854 with a sensational thesis on the synthesis of natural fats from glycerin and the fatty acids. A continuation of these researches, especially on the polyatomic alcohols led, in 1863, to the founding of the chair of organic chemistry at the Collége de France, that he might have the conditions for carrying out his personal ideas. He thus entered on a field of work which made him famous. *Analysis* had until this period been the chemist's aim. *Synthesis* now claimed his attention, and before the end of the nineteenth century wonders were indeed wrought, revolutionizing both philosophy and the arts.

By causing an electric arc to play between carbon electrodes in an atmosphere of hydrogen Berthelot secured the direct union of carbon and hydrogen with the production of acetylene. He then converted this by the action of heat into benzene, and from these passed to other syntheses. He also experimented with the silent discharge turning oxygen to ozone. With the induction current he combined acetylene and nitrogen to hydrocyanic acid. He obtained formic acid starting from carbon monoxide. By the use of sealed tubes in which chemicals were subjected to high temperature and pressure through considerable time he influenced them to combine, and also gave us a new general method in chemical manipulation. Six important works, in all nine volumes, attest his genius as applied to this department of his labors. His soul was in his work. When one contemplates how his experiments steadily progressed, effecting the grouping of the elements to form hydrocarbons, alcohols, acids, ethers, sugars, fats, thus simulating natural processes and building up compounds which up to his day were conceived as being solely the result of vital force, we little wonder that he became permeated with the idea that ultimately man would manufacture his own sustenance. In his address to the second International Congress of Applied Chemistry he says: "No one can deny that the day is perhaps near when the progress of chemistry will realize the manufacture of foods; in that day the cultivation of wheat and the raising of cattle will be exposed to the same destiny which has overtaken the culture of madder in our day." What perplexing situations will then arise with reference to the pure food law!

Berthelot took an active part in the great movement of the middle of the nineteenth century when the correlation of the sciences was discussed and the conservation of energy was established as the basis principle in physics. It was, therefore, natural that he should attempt to measure the energy developed by chemical reactions in definite terms. He labored indefatigably for thirty-five years in founding thermochemistry. The facts and principles are collected in two volumes pub-

lished in 1897. They had been preceded by a work entitled 'Essai de Méchanique Chimique,' also in two volumes, 1879, followed by a volume, 'Traité pratique de Calorimétrie chimique,' 1893. His two volumes 'Sur la force des matières explosives,' 1883, was intimately connected with these other laborious researches in thermochemistry, and led to the discovery by others of smokeless powder. His work on the detonation of endothermic substances, such as cyanogen and acetylene, was followed by a research on explosive waves by which he elucidated many seeming contradictory facts. During the stirring times of 1870 Berthelot was made president of the scientific committee on defense; he afterwards became consulting member of the committee on powder and saltpetre, and president of the commission on explosives. In connection with these duties he devised many original methods of research.

His thesis that chemical phenomena are identical in animate and inanimate nature is thus expounded in 1855:

> we may, I say, claim to form anew all the substances which have been developed since the origin of things, to form them under like conditions in virtue of the same laws, by the same forces which nature brings into play in their formation.

And as a necessary sequel of his life's work we find him attacking the serious problems of the theory of agriculture and of biological chemistry. His 'Chimie Agricole,' in four volumes, and his 'Chimie Animale,' in two volumes, were both published in 1899.

The beautiful experiment farm at Meudon was the scene of his labors. One climbs the 'tour Berthelot' of over eighty feet in height and about one is the charming scenery of this suburb overlooking Paris. Here the master undertook his experiments on the influence of electricity on the growth of plants—generating this force or deriving it from the atmosphere. Here it was that the fixation of nitrogen was studied, a problem that has engaged the sturdiest minds, and here it was that he found that microbic life was the means of transferring atmospheric nitrogen to the living plant cell. The import of this phenomenon he tersely stated in saying: 'The soil is something alive!' To us the products of whose broad acres furnish enough for ourselves and to spare this discovery is of incalculable value. And yet this man, who instructs us in economic farming, does not hesitate to indicate how we may manufacture our own food and thus make ourselves independent of climatic influences.

The experimental investigation on plant life led to that of the animal organism. The principles of the production of heat in living beings was a topic quite germane to the investigations on thermochemistry.

While Berthelot found his greatest pleasure in experimentation in science he was fully alert to the intimate relations his investigations bore to the advancement of the liberal arts. He made his position in this regard quite clear to the audience he addressed at the second International Congress of Applied Chemistry:

> In chemistry, as in all studies useful to man, theory and practise are related to each other by indissoluble bonds.
>
> Senseless the theorist who, shutting himself up in the solitude of his egotistical personal views, affects to disdain the incessant applications of science to civilization, for the wealth and happiness of mankind!
>
> Senseless, no less senseless, the practical man who, satisfied with the knowledge acquired by his ancestors, out of admiration for their conservatism and tradition, opposes all progress, refuses to enlarge or change the processes used in his industry, that it may remain each day in complete accord witn the newest and most advanced theory!
>
> No science probably, more than chemistry, shows the necessity of this constantly renewed harmonious relation between practise and theory.

To-day the traffic of this great city, the incessant tide of travel, the lighting of its streets and homes, is effected by the aid of electricity generated by the burning of coal, and the specifications, under which the coal is bought, require that its calorific value shall be determined by the bomb calorimeter, invention of Berthelot, devised for theoretical purposes.

While a great theorist, he invariably had recourse to the experimental method for establishing his premises on a sure foundation. His temperament was that of an idealist, of

a literateur, yet he foreswore in part his allegiance to science to serve his country.

France had honored him by the bestowal of many favors in recognition of his labors. Member of the Institut, 1900, grand officer of the Legion of Honor, 1886, perpetual secretary of the Academy of Sciences, 1889, succeeding Pasteur; but she also made him senator for life, 1881, gave him the portfolio of the Minister of Public Instruction and the Fine Arts, 1886, and made him Minister of Foreign Affairs, 1895, and he served his country with ardor.

The fiftieth anniversary of his first scientific publication was celebrated at the Sorbonne on November 24, 1901. Official delegates of foreign scientific societies voiced their congratulations. The French Academy, in a stirring discourse delivered by Moissan, 'tendered him its homage and thanked him for having given it a little more of truth.' All departments of the government were represented at this unique festival. A beautiful medal, by Chaplain, bore on its face the likeness of Berthelot and the inscription, 'La Synthese Chimique. La Science Guide l'Humanité.' On the reverse side the savant appears seated before his laboratory table, on which is placed now classical apparatus, while above are two figures typifying the inscription 'Pour la Patrie et la Verité,' and the president of the republic, M. Loubet, as he handed him this gift, kissed the dear old man in token of the love and gratitude of the nation and in behalf of his admirers of all other nations.

Berthelot was particularly happy in his surroundings. He was constantly in his laboratories in Paris, Meudon and elsewhere; it was here that his *positive* science claimed him. In late years he resided in the Institut, a palace formerly occupied by Cardinal Mazarin. It was here, surrounded by his family and friends, that he enjoyed his *ideal* science.

He married early in life a beautiful and charming woman by whom he had five children, the four sons surviving. The forty-five years of married life came to a dramatic end. Both husband and wife suffered from heart trouble. Berthelot, anxious about his partner's failing health, was ever watchful. He left her to be present at the semi-monthly meeting of the academy, but returned shortly —only in time, however, to be with the beloved one in her last moments. Shattered by the blow he was led to a couch in his work room. Alas! The strain had been too great and his own heart, weakened by age and the present anguish, ceased beating.

On March 25 this noble man and woman were given public obsequies. The great Pantheon was filled with the representatives of all branches of the government from President Fallières down. The edifice was crowded with distinguished men and women. As the two bodies rested on catafalques M. Briand gave an eloquent discourse. Afterwards the body of Berthelot was placed on another catafalque before the church and the army passed in review, saluting the great dead. In the afternoon the public did him homage, and towards evening he and his dear wife were placed in the crypt, not far from the remains of Victor Hugo.

In his peroration to the second congress Berthelot summed up his views of life; he fulfilled them in his own:

> Our duty is clearly outlined. Let us be doing, that is let us work! Work without cessation; let us try to be useful. Diligence and the love of mankind! This is the true aim of both home and public life.

CHARLES G. DOREMUS

THE GEOLOGICAL SURVEY AT JAMESTOWN

Under the general direction of Mr. David T. Day, a comprehensive exhibit of the geologic, topographic, and hydrographic work of the United States Geological Survey will be made at the Jamestown Tercentenary Exposition. The geologic data will be prepared by Mr. J. S. Diller, the topographic by Mr. H. M. Wilson, and the hydrographic by Mr. M. O. Leighton.

A pillar of mounted geologic maps will be one of the most important exhibits. It will include maps from 70 of the Survey's folios, representing areas throughout the United States.

Special maps have been prepared showing the general distribution of important economic mineral products east of the Rocky Mountains. These will include maps showing the

distribution of coal and iron, of oil and gas, of cements, phosphates, and glass, of gold, silver, copper, lead, and zinc. The minerals and ores whose distribution is shown on the economic maps will be illustrated by a small collection of specimens in an adjoining case.

The colored geologic map of North America, which was prepared by the Survey in cooperation with the Geological Surveys of Canada and Mexico for the International Geologic Congress, which met in Mexico last fall, will also be exhibited.

A collection of coals and other economic minerals, the distribution of which is shown on the economic maps, will be presented.

On the flat surface of a map it is difficult to show clearly the relief of the country represented, but by means of a model it can be fully expressed. For this reason a number of models have been prepared to illustrate some of the most important relief features and economic resources of the country tributary to the Jamestown Exposition. These include geologic models of the southern Appalachian region, the New River coal field, and the Philadelphia region, a topographic model of the Atlanta-Chattanooga region and a topographic and geologic model of Alaska. A collection of Alaskan minerals will be especially interesting when studied in connection with the model of Alaska.

The educational series of rock specimens prepared by the Survey for teaching geology will be exhibited. Two hundred similar collections, each containing 156 specimens illustrating the various types of rocks, have been distributed to the universities and colleges of the country.

The machine used by petrographers for grinding thin sections of rocks will be exhibited. The method of preparing thin sections and their kaleidoscopic appearance under a polarizing microscope will be illustrated.

A complete set of survey publications, including topographic and geologic maps, annual reports, monographs, professional papers, bulletins, water-supply papers, and mineral resources will be on file.

The method of storing and arranging the large number of maps and folios for convenient use in public and private libraries has been given much attention, and the best cases yet devised for the purpose are exhibited.

RESEARCH FELLOWSHIPS IN ENGINEERING AVAILABLE AT THE UNIVERSITY OF ILLINOIS

The University of Illinois has extended and strengthened the field of its graduate work in engineering by recently establishing ten Research Fellowships in the Engineering Experiment Station. These fellowships have an annual value of $500, and are open to graduates of approved universities and technical schools, both American and foreign. They must be accepted for two consecutive collegiate years, at the expiration of which period, if all requirements have been met, the Master's degree will be granted. Preference will be given to men who have had some experience in practical engineering work outside of college. The appointments will be made upon the recommendation of the Station Staff of the Engineering Experiment Station, and upon the approval of the Faculty of the Graduate School and the President of the University.

The Engineering Experiment Station, it may be explained, is a department connected with the College of Engineering. It was established in 1903 for the purpose of carrying on investigations along various lines of engineering, and for the study of problems of importance to professional engineers and to the manufacturing and industrial interests of the state. The work of the station and the college is closely related, the heads of the several departments of the college of engineering constituting the station staff. The investigations are carried on by the members of the staff directly, sometimes by a fellow as graduate work, sometimes by a member of the instructional force of the college, and frequently by special investigators belonging to the station corps.

The various laboratories of the station and the college offer exceptional facilities for investigational work, being well-equipped with the most modern apparatus. During the past four years about $300,000 has been appro-

priated by the state legislature for the maintenance and extension of this equipment, and it is believed that the same liberal policy will be continued.

By offering these research fellowships at $500, and throwing them open to graduates of both American and foreign universities, the station hopes to secure a picked body of men imbued with the true spirit of genuine investigators who will do graduate work of high grade. It is expected that valuable results will accrue to the station, and that a body of experts will be developed, some of whom may be attached later to the regular corps of station investigators. A circular giving full information will soon be issued, and can be obtained upon application to the director of the Engineering Experiment Station, Urbana, Illinois.

L. P. BRECKENRIDGE,
Director of the Engineering Experiment Station.
UNIVERSITY OF ILLINOIS,
URBANA, ILL.,
February 23, 1907

THE CARNEGIE INSTITUTE

MR. ANDREW CARNEGIE on April 6 notified the president and board of trustees of the Pittsburg Carnegie Institute that he was sending them $6,000,000. Of this amount $5,000,000 is United States Steel Corporation 5 per cent. bonds and $1,000,000 in cash. The cash is to be used in erecting more technical school buildings. The bonds are an endowment. One million dollars is to be added to the endowment of $2,000,000 already given the schools, and the other $4,000,000 is to be added to the institute's present $2,000,000 endowment.

In his letter, as published in the daily papers, Mr. Carnegie says:

> The director and teachers of the Technical Schools participate in the pension fund established by me for the advancement of learning, and this should be availed of. Those of the other departments do not. A pension system is, therefore, to be established for them out of the endowment fund; after the death of the recipient the pension to be continued to the widow in all cases where needed.
>
> I desire gratefully to acknowledge my unpayable indebtedness to yourself and the trustees for services which have resulted in such complete triumph. My highest hopes will be realized if the future yields such golden harvest as the past.

As we have already announced, the dedication of the new building of the institute, erected by Mr. Carnegie at the cost of $5,000,000, will take place on the afternoon of April 11, and will be attended by many distinguished guests from Europe and the United States. The program which has been arranged in connection with the ceremonies will last for three days. In addition to a reception and inspection of the buildings on Thursday morning and a concert in the evening, there will be on Friday a reception at the Carnegie Technical Schools, a presentation of addresses, and in the afternoon speeches by distinguished guests and in the evening a dinner by the trustees in honor of Mr. and Mrs. Carnegie and invited guests. On Saturday morning honorary degrees will be conferred on foreign guests by the Western University of Pennsylvania, and in the afternoon there will be an excursion on the river and a visit to the Homestead Steel works of the Carnegie Steel Company.

SCIENTIFIC NOTES AND NEWS

THE spring meeting of the council of the American Association for the Advancement of Science will be held in the Assembly Hall of the Cosmos Club, Washington, D. C., on the afternoon of April 17, 1907, at 4:45 P.M.

THE annual session of the National Academy of Sciences will be held in Washington, D. C., beginning on Tuesday, April 16, at 11 A.M. The place of meeting will be the National Museum.

THE American Philosophical Society will hold its annual meeting at Philadelphia on April 18, 19 and 20.

DR. GEORGE OTIS SMITH has been appointed director of the U. S. Geological Survey to fill the vacancy caused by the election of Dr. Charles D. Walcott to the secretaryship of the Smithsonian Institution. Dr. Smith received the bachelor of arts degree from Colby College in 1893, and the doctorate of philosophy

from the Johns Hopkins University in 1906, in which year he was appointed assistant geologist to the Geological Survey, being made geologist in 1901. He has had charge of the geological work in New England, and is now geologist in charge of petrology.

On March 13, a banquet was tendered to Dr. Charles D. Walcott, by the members of the U. S. Geological Survey, on the occasion of his resignation as director to become secretary of the Smithsonian Institution. Two hundred and forty-four persons were present. Colonel H. C. Rizer presided, and addresses were made by the following men: Mr. Bailey Willis for the geologic branch, Mr. W. M. Beaman for the topographic branch, Mr. M. O. Leighton for the water resources branch, Mr. S. J. Kübel for the division of engraving, and Mr. F. H. Newell for the reclamation service. Dr. Charles B. Dudley spoke of the fuel-testing work of the Geological Survey. A letter from Mr. Arnold Hague was read, as also a telegram from Mr. Henry Gannett. Mr. Gifford Pinchot paid a tribute to Mr. Walcott in relation to the forestry work of the government. The closing address was by the Hon. James R. Garfield, secretary of the interior.

Lord Lister celebrated his eightieth birthday on April 5. Congratulations were received from all parts of the world, and a committee acquainted him with the plan to republish his scientific papers.

M. Jules Tannery, professor of differential and integral calculus at the Sorbonne, has been elected a member of the Paris Academy of Sciences.

Professor J. Burkitt Webb, of the chair of mathematics and mechanics, and Professor William E. Geyer, of the chair of physics, of the Stevens Institute of Technology, will retire from active service at the close of the present academic year.

Professor W. O. Crosby, in charge of the work in economic geology in the Massachusetts Institute of Technology, will retire from active teaching at the end of this year on the Carnegie Foundation for the Advancement of Teaching. As student and teacher, Professor Crosby has been connected with the Institute of Technology continuously for a period of thirty-six years, and the connection is to continue; but the time heretofore given to routine instruction will now be devoted to research.

Officers of the Michigan Academy of Sciences have been elected as follows: *President,* Mark S. W. Jefferson, State Normal School, Ypsilanti; *secretary and treasurer,* E. E. Bogue, Michigan Agricultural College; *assistant secretary,* Walter G. Sackett, Michigan Agricultural College; *librarian,* G. P. Burns, Ann Arbor; *vice-president, botany section,* W. E. Praeger, Kalamazoo; *zoology,* A. G. Ruthven, Ann Arbor; *geology,* Professor E. H. Krauss, Ann Arbor; *sanitary science,* J. G. Cummings, Ann Arbor.

Professor W. M. Davis, of the department of geology and geography and dean of the graduate school, will represent Harvard University at the dedication of the new building of the Carnegie Institute in Pittsburg.

Professor Carl Hess, of Würzburg, will be a guest of the section on ophthalmology of the American Medical Association at the Atlantic City meeting in June. He comes in April to deliver lectures before the universities of Pennsylvania, Chicago and New York.

Dr. Herbert J. Webber, chief of the Division of Plant Breeding Investigations of the Department of Agriculture, assumed last week the duties of the chair of plant biology at Cornell University.

Dr. J. W. Blankinship, recently professor of botany at the Montana Agricultural College, is now connected with the Missouri Botanical Garden, St. Louis, Mo.

Mr. C. W. Gilmore, of the National Museum, under a grant just approved by the secretary of the Smithsonian Institution, will be sent to Alaska to undertake paleontological explorations with a special view to securing specimens of fossil mammals. Continuing his work over two seasons, 1907 and 1908, he will confine his explorations mainly to the Yukon Basin region southeast of Norton Sound, and to the Buckland River region southeast of Kotzebue Sound. Mr. Madren, who was Mr.

Gilmore's predecessor in the Alaskan field, found many remains of mammoth, large bison and horses of a peculiar type.

PROFESSORS R. T. JACKSON and J. B. WOODWORTH, of the department of geology and geography of Harvard University, will conduct a paleontological and geological excursion to Yorktown, Va., during the April recess, leaving Boston on Friday night, April 12.

DR. SCHILLING, head of the department of tropical hygiene in the Berlin Institute of Infectious Diseases, has been granted by the government eight months leave of absence in order that he may pursue researches on immunization against tsetse fly disease. In the course of his work he will make an expedition to the Congo.

DR. JOSEPH LARMOR, Lucasian professor of mathematics at Cambridge University and secretary of the Royal Society, presented an address before the Washington Academy of Sciences, on April 2, 1907, on 'Modern Views of the Ultimate Structure of Matter.' It was discussed by Professor F. W. Clarke, of the U. S. Geological Survey, and Professor A. G. Webster, of Clark University.

MR. ELIHU ROOT, Secretary of State, has accepted the invitation of Yale University to deliver the annual Dodge course of lectures on 'The Responsibilities of Citizenship.' He will speak on May 13, 14, 20 and 21.

DR. L. A. BAUER gave an address, illustrated by lantern slides, before the Society of Arts of the Massachusetts Institute of Technology at Boston on March 28 on 'Recent Results of Terrestrial Magnetic Observations.'

LORD AVEBURY will preside at the annual *soirée* of the Selborne Society, which will be held in the halls of the Civil Service Commission on April 26. Illustrated addresses will be given, and there will be a display of microscopes and objects of interest.

M. EDOUARD HOSPITALIER, professor of electrotechnic at Paris, has died at the age of fifty-four years.

THE death is also announced of Dr. Rudolf Aderhold, director of the Biological Institute for Agriculture and Forestry at Berlin, at the age of forty-two years.

ON May 8, there will be civil service examination for the positions of laboratory assistant and assistant physicist and laboratory assistant and assistant chemist in the Bureau of Standards, the salaries varying from $900 to $1,600.

THE third regular meeting of the Botanists of the Central States was held at the University of Wisconsin, Madison, Wisconsin, March 28–30. There was a representative attendance of botanists at the meeting, and a number of papers were read. One session was devoted to the demonstration of microscopic preparations. Professor F. C. Newcombe, of the University of Michigan, the retiring president read an address entitled 'A Need in Botanical Science in America.' Professor T. H. Macbride, of the University of Iowa, was elected president for the ensuing year.

THE seventy-ninth Congress of German Men of Science and Physicians will be held at Dresden this year from September 15 to 21.

UNDER the auspices of the University of Illinois, a commission has been organized for the purpose of conducting experiments on the effect on the consumer of the preservatives in common use in food stuffs, especially meats. The work will be done under the direction of Professor H. S. Grindley, of the department of physiological chemistry of the university, and with him on the commission are R. H. Chittenden, professor of physiological chemistry, Yale University; J. J. Abel, professor of pharmacology, Johns Hopkins University, and A. P. Mathews, professor of physiological chemistry, University of Chicago. The expense of the investigations is to be borne in part bv the university and in part by some of the beef-packing houses of Chicago.

MR. FRANK LEVERETT and other members of the United States Geological Survey are authors of two papers on flowing wells and municipal water supplies of the southern peninsula of Michigan. The results of their studies, so far as they apply to the southern counties, are embodied in Water-Supply and Irrigation Paper No. 182; so far as they apply

to the middle and northern counties, in Water-Supply and Irrigation Paper No. 183, both of which are free publications. In the course of glacial investigations made under the direction of Professor T. C. Chamberlin during the last five years, Mr. Leverett collected a large amount of data on water supplies. These investigations resulted in a partial acquaintance with conditions in about 200 separate flowing-well districts and brought out matters of such exceptional importance that arrangements were made to examine each of the flowing-well districts in the state sufficiently to determine its essential characteristics, present state of development, and probable capacity for future development. It was arranged also that attention should be given to the quality of various classes of waters, both surface and underground, as well as water supplies of the cities and villages. By special arrangement with Dr. A. C. Lane, the state geologist, the large amount of material which had accumulated at his office relative to other classes of water supply was embodied in these reports.

UNIVERSITY AND EDUCATIONAL NEWS

By the will of Mr. William C. Eggleston, Yale University has received $100,000 as an additional endowment for the library. By the Ross legacy the university has $75,000 for maintenance in addition to the sum of about $200,000 used for the building. Yale University has also received about $95,000 as residuary legatee, after the death of his widow, of the late William L. McLane.

Mr. Benjamin Thaw, of Pittsburg, has given $50,000 to the fund for the new building of the Western University of Pennsylvania.

We regret to learn that the Macdonald engineering building of McGill University was completely destroyed by fire on April 5, involving a loss of about $750,000, of which $450,000 is covered by insurance.

The College of the City of New York will celebrate the sixtieth anniversary of its foundation on May 7.

The University of Iowa will this year celebrate the sixtieth anniversary of its foundation. Secretary Taft will give the commencement address on June 12.

The University of Berlin will celebrate the centenary of its foundation in the autumn of 1910. As part of the ceremonies a monument will be unveiled in memory of its first rector, Johann Gottlieb Fichte, the philosopher.

The Divinity School of Yale University has proposed changes in its curriculum, its scope and its relations to other departments which have been adopted by the corporation. The new curriculum provides, in addition to the regularly recognized courses of theological study, two other main groups of electives in which the study of Hebrew is not required for the degree of B.D. Sciences and philosophy are to be specialized in one of these groups of study and elementary law and sociology in the other. These subjects will be pursued by the divinity students for the most part in other departments of the university.

Professor B. E. Fernow, lately called to the professorship of forestry at State College, Pennsylvania, which he had temporarily accepted, has been appointed dean of the Faculty of Forestry at the University of Toronto. It is proposed to organize the most complete system of forestry education on this continent, the university undergoing now a reorganization and broadening of its policy generally. It is expected that a large forest reservation will be set aside for use of the school, and university extension work of the broadest kind is contemplated.

At Teachers College, Columbia University, Dr. Maurice A. Bigelow has been promoted from adjunct professor to professor of biology.

The vacancy in the chair of biology in Lake Forest College, caused by the removal of Professor James G. Needham to Cornell University, has been filled by the election of Dr. Cornelius Betten, previously assistant professor in the same department.

Mr. W. Muir Edwards, lecturer in mathematics and civil engineering at McGill University, has been appointed assistant professor of civil engineering.